The Sewerage of Kansas City.*

BY O. CHANUTE, M. AM. SOC. C. E.

I am very much obliged to Mr. Moore for the honor which he has done me in criticising my lecture upon the Sewerage of Kansas City.

At the very outset of that lecture I requested that it should be critically received, so that whatever was sound might stand, and whatever was erroneous might be eliminated, and I am gratified that Mr. Moore has been at so much pains to muster adverse arguments, data and authorities on the subject. This cannot but promote the object which we both have in view, of getting at the truth, as to what it is actually best for the people of Kansas City to do about their sewerage.

I must say, however, that my opinion has not been changed, and that the reasons which Mr. Moore has given, do not seem to me to be good reasons why the separate system should not now be adopted for the greater part of that portion of Kansas City as yet unprovided with sewers.

He first assumes that storm-water will prove such a nuisance in all parts of the city that storm-water sewers should be provided everywhere to abate it.

This conclusion is, I think, erroneous and unsound for a city which is being built, and must remain in so promiscuous and scattered a condition, as Kansas City. Instead of growing up a compactly built town, gradually extending itself into the suburbs, like St. Louis, for instance, it resembles rather an agglomeration of several towns, separated by precipitous bluffs, and has a curiously complicated and broken topography.

Here and there are rows of stores and dwellings with many reaches of vacant lots and rough ground between them, and while only about one-seventh of its area is as yet sewered (upon the combined system), this comprises pretty well the business portion of the city.

If, therefore, the combined system be adhered to, its great cost, together with the prevailing uncertainty about the future grades of the streets, which are being constantly changed, must so far delay the construction of sewers as to leave undrained for a long time many portions of the city, where the soil is now being polluted and poisoned by cesspools, as was that of Memphis.

If, however, the separate system be now adopted, it can by reason of its lesser cost be at once extended where needed, and when storm sewers become required. (for I do not claim that none will be needed) they can be confined to those short sections in which storm water positively proves a nuisance.

I therefore deny Mr. Moore's assumption that if storm sewers are ever to be required they might as well be put in first as last; that we should go on with expensive plans now, for fear we may have to resort them some time hence. This may seem wise to the men who plan the works, but the people who have to pay for them may entertain a different opinion.

Not only do I deny the present assumed necessity, but I also deny that the future necessity for storm water sewers in Kansas City will be anything like so great as Mr. Moore has assumed. He has not sufficiently considered the fact that if rain water is not polluted with sewage the future storm sewers may be confined to those short sections where serious annoyance occurs; that these will be at shallow depths and that the water may again be carried on the surface where the situation admits of it, while with the combined system, the foul mixture of sewage and rain water must be carried under ground, all the way to a final outlet, and at the full depth required to drain the cellars.

I think the experience of engineers in cities having the combined system is misleading. They deal with the double requirement of carrying the foul house sewage under ground and of abating an occasional nuisance, and while the property owners might be quite content to have an occasional rivulet in front of their premises or flooded gutter at the street crossing, would prefer it in fact, as do the citizens of Baltimore, for the sake of the resulting clean streets, were no combined sewer at hand to tempt them, the engineers fail to realize that storm sewers are really not needed at all points.

It seems to me that this question as to the future necessity of storm water sewers is best tested by the practical experience of towns with the separate system. A number of cities have been so sewered in England and in this country, and thus far not one of them, to my knowledge, has been led to carry out a second system of storm sewers coextensive with the first sewage system, as Mr. Moore would lead us to believe will be the case.

But Mr. Moore says that the experience of these cities does not apply, because they are small. That, while surface channels or small sewers may be tolerated in small towns, large cities require large sewers. This argument is an old acquaintance, which has repeatedly done service in opposition to the separate system. In point of fact there is little or no force to it, and it does not apply to Kansas City, because its topography makes it, what it must remain, an agglomeration of several towns, and because, after all, plans have to be made appropriate to the requirements of each case. The proper treatment will differ even in various parts of the same city, and I may as well confess here that on the flat bottom lands of East and West Kansas City I would advise probably the combined system, while for the sharply undulating city on the hill, the portion which we are generally thinking of when we speak of Kansas City, I advise the separate system.

This portion of the town site much resembles that of Baltimore in the steepness and short drainage area of its streets; and Baltimore, with its 322,000 inhabitants, has but 11 miles of storm sewers, while St. Louis, with 360,000 people, has 318 miles of combined sewers; and Mr. C. H. Latrobe, in his report to the Mayor and City Council of Baltimore (August, 1881) says: "It is probable that a few more sewers, added to what we already have, will effectually accommodate the storm water where it is convenient, and leave us unhampered to construct the other branch of the separate system, which shall take care of the sewage proper, relieve our gutters from slops and refuse of all kinds, and enable us to get rid of the cesspools."

Now, notwithstanding its small amount of sewers, Baltimore has notoriously clean streets (which is more than can be said of St. Louis), and I even fancy that the streets of Kansas City which are sewered are not now as clean as they were in the old days, when the storm waters swept over them.

Kansas City has now (December 31, 1883) some 21½ miles of combined sewers, which have cost $445,748, or say $20,727 per mile, and I estimated in my lecture that perhaps $150,000 more might be required for storm water sewers proper if the separate system be adopted now, while I stated that even if this amount were doubled, there would still be a notable economy over the continuance of the combined system. So far, therefore, from assuming that surface removal of storm water is *all* that is required, I think that I made a liberal provision for the abatement of the storm water nuisance, which my acquaintance with the town site of Kansas City, now dating back some 17 years, leads me to believe will not be one-tenth as great as Mr. Moore has represented.

I think, therefore, that the wise plan for Kansas City now to adopt is first to provide for the drainage of the cesspools; to stop the further pollution of the soil, and to take up the disposal of storm waters only so fast as nuisance arises, especially as they can be confined to those short lengths where serious annoyance does occur, and then be placed at shallow depths, say 2 to 5 feet, instead of being carried, as now, from 10 to 16 feet under ground, to drain the cellars in the same set of pipes as the house sewage.

For this reason I also dissent from Mr. Moore's second assumption "that as storm water sewers will be a necessity, it is certainly cheaper to use them for house drainage than to construct another system for that purpose."

He leaves the latter dictum entirely unsupported by estimates or figures, and so far as I have been able to obtain the latter they point just the other way.

For instance, the cost of the combined system in St. Louis has been $30,146 a mile. In Brooklyn, New York, it has been $25,600 a mile, and the cleaning costs $133 a mile yearly. In Providence, Rhode Island, the first cost has been $34,550 a mile, and the cleaning cost $282 a mile annually, while in Memphis the cost has been $6,875 a mile, and the sewers are cleaned and repaired at a cost of about $70 a mile a year.

When Memphis, fever stricken and ruined, turned to sanitary engineers for advice, the sewer builders of the combined school proposed several plans varying in cost from $800,000 to over $2,225,000, depending upon the amount of storm water to be accommodated. Mr. Waring, however, put in about 18 miles on the separate system in 1880 at a cost of $137,000, and the city authorities have since added about 22 miles more, at an additional cost of about $138,000, thus making a total cost of $275,000 for some 40 miles of sewers at the close of 1883, which are said to drain even more territory than was contemplated in the estimate for combined sewers. No storm water sewers have yet been added, probably because the storm water, ever in that moist climate, has not yet proved to be the terrible nuisance that Mr. Moore would have us imagine. When they are needed it is probable that they will be put in at those points where they are required, for a good deal less than the difference between $275,000 and $2,225,000.

But we have evidence nearer at home. The separate system of Leavenworth, Kansas, now approaching completion, has cost less than $10,000 a mile, or, to give it in the way in which we pay our sewer assessments, it has cost 44½ cents a square (of 100 square feet) for the house drainage proper, and, including the outlets, only 65½ cents a square; while the combined system of Kansas City has cost to Dec. 31, 1883, some $2.10 a square. I submit that the resulting difference of $1.44½ a square will pay for a good deal of storm sewers, which, be it remembered, will be shallow, while the Leavenworth pipes for sewage proper are from 7 to 27½ feet under ground.

I may mention here, in passing, that Mr. Latrobe's estimate for a separate system for Baltimore also shows a cost of about $10,000 a mile, and that this may fairly be assumed as the probable cost at Kansas City for the house sewage proper.

Now, the cost in the latter city for the combined system has thus far been $20,727 per mile, and 7.16 miles were built last year. Let us suppose (to confine ourselves to a very brief period of time) that the city goes on at the same rate for only five years more. It will according to the above data, still spend some $350,000 more for the combined sewers than if it now inaugurates a separate system.

The people of Kansas City know just how much of a nuisance the storm water is now in the unsewered portions of their city. It is for them to determine whether they are willing to spend some $70,000 a year to abate it during the next five years.

But as a reason why this economy cannot be realized Mr. Moore says that "the map show

* Delivered before the St. Louis Engineers' Club, March 12th, 1884, and reduced to writing at the request of the club. Reprinted for Journal of Association of Engineering Societies for March and April.

the shortest slope in the direction of the streets, from the crest of the ridge to the river to be 3,500 feet. That on such grades storm water in the gutters becomes a serious matter after it has run five or six hundred feet. Beyond that distance it becomes a raging torrent, sweeping everything before it, and rendering the cross-streets for the time being impassable. I should say that a thousand feet, or less than one-third of the shortest slope, was the limit of endurance, leaving the other and lower two-thirds to be in any event provided for by sewers."

Now it is a peculiarity of the situation at Kansas City that the lower third of this slope is practically through waste land, at present, at least. The business and residence portion of Kansas City is built upon a bluff about 200 feet high bordering upon the river. A mistake was made in the early laying out of the town site in attempting to make it conform to that of St. Louis and other river towns, by cutting a number of very steep streets from the river inland. These cuts made great gulches from 80 to 100 feet deep, on which few or no houses have been built. The river front of the town, therefore, instead of being covered with residences (like Columbia Heights in Brooklyn), is occupied by brick yards, which are nibbling at the hills, and as even these are 40 or 50 feet above the bottom of the gulches, the raging torrents which Mr. Moore depicts as tearing down the gutters, create no particular nuisance.

It is a further peculiarity of the situation that Mr. Moore informs me that he has measured this 3,500 feet slope, along the line of Broadway, from Twelfth street to the river. Now the property which I own is situated precisely on this street. The first piece is near Ninth street, just about 1,000 feet below Twelfth street (Mr. Moore's "limit of endurance"), and the last piece is at Seventh street, about 1,500 feet below the "crest of the ridge." I have not yet found, in some sixteen years' ownership, the storm water to be the unendurable nuisance that Mr. Moore imagines, and this leads me to disbelieve his assumption as to the rest of the city.

Such is the difference between theory and local experience. I know how it is myself, and if anybody is to be ruined by the storm water nuisance on that street, in case the separate system be adopted, I shall be one of those to suffer. I am willing to chance it, and inasmuch (as Mr. Moore judiciously points out) "the rains will still fall on the streets" I prefer, like the citizens of Baltimore, that the storm water, instead of trickling a faint slimy streamlet into the corner catch basin, shall come down with sufficient volume and force to wash the dirt and rubbish (including straw) which may accumulate in front of my premises, down to my brick-making neighbors.

But as Mr. Moore rightly says, the sanitary question is of vastly greater importance than the saving in cost. Upon this question he seems quietly to have ignored all that has been said on the subject by sanitarians, both in this country and in Europe, and to my mind his argument simply proves that the combined system is better than no sewers at all.

The evidence which I chiefly quoted at the time of my visit to Kansas City two years ago, was the following extract from the report to the Board of Health of the State of New York, on sewerage; and much as I dislike to quote the same thing twice, even to a different audience, I will take up your time by reading a part of it.

"*The Combined System of Sewerage.*—This system of sewerage can only be economically used where it is necessary to provide, even at large expense, for carrying off the storm water underground. The storm water falling per hour in violent rains over an acre of closely built up city land is nearly fifty times the amount of the waste water and sewage produced per hour on the same area. The sewage is, therefore, ordinarily a mere trickling thread in the bottom of a sewer large enough to carry off great bodies of storm water. In time of rain the sewer will be nearly or quite full of dilute sewage, which is absorbed by the bricks, and leaves a coating on them as the water falls. The powerfully flowing stream of storm water on subsiding, deposits silt in the bottom of the sewer, which obstructs the flow of sewage, giving it time to decompose. Foul gases are then emitted, and it has been popularly assumed that these gases, called 'sewer gas,' are the cause of disease.

"Physicians are agreed upon the fact that air from sewers passing into a dwelling is very likely to produce serious disease. That this illness is due to a *gas* from decomposing sewage is a mere assumption unsupported by proof. But the hypothesis was hastily adopted by engineers, who naturally inferred that the healthfulness of large sewers would be secured if they could only drive out or sufficiently dilute this gas by ventilating the sewer, or prevent its formation by keeping the stream of sewage flowing uninterruptedly. The discussion of the subject by Mr. Eliot C. Clarke, in the Massachusetts Board of Health report,* and the opinion of other engineers who favor large sewers, seem to be based on this idea.

"It is time, therefore, to call attention to the fact that *no such gas as 'sewer-gas' exists* and that *there is absolutely no proof that the diseases which attend the admission of sewer air into a dwelling are produced by gases.* On the contrary the whole tendency of modern investigation is to show that the zymotic diseases are produced by *bacteria*, whose germs are developed under favorable conditions. It is well known that the most favorable conditions for the growth of these low organisms are heat, moisture, darkness and the *presence of ammonia.* The damp walls of sewers present, therefore, all the requirements for a most flourishing growth of bacteria, whose germs may float off on the sewer air and be carried into dwellings by mechanical action, as dust is borne on any air current.

"It is, therefore, most probable that sewer air brings the germs of disease into dwellings as dust is blown into the window. The foul gases of decomposition may or may not be present. The fatal power over life lies, probably, in the little plant-seed, odorless and invisible, floating upon the sewer air.

"Large sewers are, then, plantations for the propagation of deadly organism, the moist, porous walls forming most favorable soil, the ammonia of sewage supplying the manure essential to full development, and the warm, damp air stimulating to the utmost all processes of growth.

"The occasional flushing of sewers, while it may clear out silt and accumulated filth, and thus decrease the amount of heat and ammonia from decomposition, can never prevent the growth of bacteria on the sewer walls, nor will ventilation prove efficient. Every device of engineering has been exhausted to keep large sewers clean and well ventilated, but the air from them is still deadly. Experience, therefore, teaches that there is some radical defect in the system of large or combined sewers, while modern investigations of the origin of zymotic diseases and the mode of growth of bacteria seem to show that sewer walls are almost ideal hot-bed for the production of fatal organic germs. Perfect plumbing may prevent sewer air from entering dwellings, but perfect plumbing will always be the rare exception.

"In view of these facts I am forced to conclude that from a sanitary point of view the combined system of sewerage is a failure.

"I visited in London the sanitary department of the Local Government Board which has general supervision of the sanitary affairs of England. The Chief Engineer, Mr. Robert Rawlinson, C. E., and the principal medical inspectors, Dr. Ballard and Mr. Radcliffe, are perfectly agreed that the combined system of sewers is radically defective from a sanitary point of view. In this opinion Dr. Richardson and other prominent sanitarians concurred. At the meeting of the British Association for the Advancement of Science, in York, the leading civil engineers whom I met had abandoned their belief in the 'combined systems' of sewers, being convinced that it could not be made healthful.

"While all were agreed as to the failure of the 'combined system' some of the medical men favor the general introduction of the 'pail system' of Manchester of 'dry removal' of the excreta in tubs, and the use of sewers entirely, disconnected from dwelling, to carry off only waste and storm water; while Mr. Rawlinson and other engineers advocated water carriage by the 'separate system.'"

(To be concluded next week.)

* Second Report Mass. State Board, New Series, 1880.

Connecticut Civil Engineers' and Surveyors Association.

In a handsomely frescoed and carpeted room with numerous recent appliances, and many models, drawings, and photographs, of Steam Engines, stationary and locomotive, everywhere about, on the walls, on newel posts, on tables, shelves and pedestals—the headquarters of a Stationary Engineers' Association—were assembled on the 15th ult., in fairly respectable numbers, and very respectable in appearance (as is the wont of the profession) the representatives of the Civil Engineers and Surveyors of Connecticut, at 87 Church St. New Haven.

A call for an organization was issued in December last, and a preliminary meeting was held in January, at which time a temporary organization was effected. The present meeting was called for the purpose of adopting a Constitution and By-Laws, elect officers and otherwise to perfect a permanent organization. The meeting was called to order by B. H. Hull of Bridgeport, at 11 a.m. The minutes of the preceding meeting were read and approved, after which the Constitution and By-Laws were read, and after some discussion and amendment adopted. They provide as follows:

The name shall be as we have given above; the object, professional improvement, encouragement of social intercourse, advancement of engineering in its several branches, the reading and discussion of papers on Engineering topics, and the transaction of all business properly pertaining to such an an association; the officers and their duties are as in other societies of similar character; elections by ballot; no admission fee, but yearly dues, payable in advance, on enrollment of name, three dollars; annual meeting on second Tuesday in January of each year, and meetings quarterly thereafter, the time and place to be arranged by the executive committee; elegibility for active membership to be two years actual practice in engineering or surveying; honorary members may be elected.

The officers elected for the ensuing year are: B. H. Hull. Bridgeport, *President;* Chas. E. Chandler, Norwich, *Secretary;* D. C. Sandford, New Haven, *Asst. Secretary (and Treasurer Pro-tem);* A. W. Rice, New Britain, and H. J. Kellogg, New Haven, *First and Second Vice Presidents;* T. H. McKenzie, H. J. Kellogg, and H. G. Loomis, *Executive Committe.*

The following were elected *Active Members:* B. H. Hull, Hydraulic Engineer, Bridgeport; H. J. Kellogg C. E., New Haven; C. H. Bunce, City Engineer, Hartford: D. C. Sanford. Asst. Engr. Conn. Shell Fishery Commission, New Haven; Sylvanus Butler, C. E., New Haven; Wm. B. Rider, of the State Board of Engineers, and Engineer of Norwalk Waterworks; T. H. McKenzie, Engineer Southington Water-works; J. R. Patterson, C. E., New Haven; Wm. G. Smith, Chief Engineer Naugatuck R. R., Waterbury; H. G. Loomis, C. E., Hartford; Edward P. Augur, City Engineer, Middletown; J. R. Wilkes Borough, Engineer, Danbury; A. F. Spencer, C. E., Bridgeport; D. Goffe Phipps, President West Haven Water Co. New Haven; C. M. Jarvis, Engineer Berlin Bridge Co., East Berlin; Wm. E. Pettee, C. E., and Surveyor, Lakeville; Hiram Cook, President and Engineer Norwich Water Power Co., Norwich; C. E. Chandler, City Engineer, Norwich; F. F. Weld, City Engineer, Waterbury; E. H. Phipps, Engineer Conn. Cement Patent Water Pipe Co., New Haven; H. G. Schofield, City Engineer, Bridgeport; Geo. B. McEwen, C. E., Bridgeport; Wm. W. Starr, late U. S. Asst. Engr., Bridgeport; J. P. Bogart Engineer Conn. Shell Fishery Commission, New Haven; S. W. Searles, C. E., New Haven; S. E. Barney, Jr. C. E., Instructor Sheffield Scientific School, Yale College, New Haven;

D. S. Brinsmaid, Engineer Ousatonic Water Power Co., Birmingham; H. S. Whipple, C. E., Birmingham; J. M. McKenzie, Assistant Engineer Southington Water Works, Southington · J. W. Bacon, State Commissioner of Railroads, Danbury; R. J. Sabin, C. E., Pomfret; Wm. N. Fuller, C. E., Liberty Hill; F. W. Whitlock. C. E., Waterbury; W. H. Richards, City Engineer, New London; R. D. Barnes, C. E., Bristol; N. J. Welton, Engineer of Water Works, Waterbury; A. W. Rice, City Engineer, New Britain; all of Connecticut. A. H. Howland, Hydraulic Engineer, Springfield, Mass.; S. C. Heald, C. E., Worcester, Mass. *Honorary Members:* John E. Clark, Prof. Mathematics, Sheffield Scientific School of Yale College, New Haven, Conn.; C. W. Chamberlain, M.D., Sanitary Engineer, Hartford, Conn.; L. E. Gurley, Instrument Maker, Troy, N. Y.; L. W. Gurley, C. E., Troy, N. Y., and Geo. H. Frost, of *Engineering News*, New York City.

Letters were read from several engineers of the State in encouragement of the organization, and transmitting their names as applicants for memberships; also from Benjamin Thompson, Secretary of the Ohio Society of Engineers and Surveyors, expressive of satisfaction in regard to the Association, and accompanying a full set of reports of the Ohio Society, together with some hints upon organization of such a society.

President Hull, in a few brief remarks, congratulated the Association on the very favorable auspices under which it commenced its existence; he was confident of its future permanent and continued growth in numbers, in usefulness and in influence. He urged upon the members the necessity of giving such proportion of their time and thought as was necessary for the preparation of papers to be read and for attendance upon meetings, so that the society should not exist simply in name and memory, but as an actual, living factor in the improvement of the profession in the State, and through it of the public at large. Papers to be of practical import, detailing the actual construction of engineering works and difficult cases of surveying, devoid of mathematics, but such as were sure to be of interest not only to themselves, because of their local nature, but to the profession at large, who really looked to such organizations for information on every day practice, rather than for learned theoretical disquisitions. Other societies were already exerting an influence that was as yet hardly to be measured, and while in Ohio, Michigan and other Western States, the subjects of land drainage, highways and land surveying were prominent topics, in Connecticut we had to deal not only with these same subjects, but still more with the construction of dams, the development of water power, the construction of sewers and water-works, and many other problems in engineering incident to a crowded population, large cities, and busy manufacturing district.

As the entire day was pretty well occupied by the business proceedings, and owing to the absence of two papers that were to have been read, the meeting adjourned in time for five o'clock trains. The next meeting will be held in August, the date and place to be hereafter announced. There is a prospect of some very valuable and practical papers being prepared for that meeting.

WESTMINISTER, MD., April 28.—A municipal election was held here to-day to decide whether or not the city authorities should be empowered to issue $25,000 of bonds for paving the streets. The contest was a very bitter one, and there was more excitement and feeling than is usual at a general or State election. A very large vote was polled, the total being 526. The result is 32 majority in favor of issuing the bonds and paving.

Irrigation in Northern Colorado.

Written for Engineering News.

BY PROF. E. MEAD, FORT COLLINS, COLO.

Within the last five years Eastern and foreign capital has begun to seek investment in irrigation enterprises. And its introduction has produced a marked change in the character of these works. Formerly, when the works were projected by farmers, the question of dollars and cents was of far more importance than stability in construction, or the economical distribution of the water supply over a particular district. Now, however, works are being prosecuted, which, for both magnitude and character, are worthy rivals of similar enterprises in the old world.

For several reasons, those built nearest the mountains are the most important, as well as the most interesting in their engineering features. They are the first, because the land here is the most valuable, and because, being nearest the source of supplies, they are less liable to be affected by seasons of scarcity, while the broken country through which they must pass, presents many obstacles to their prosecution and gives rise to many interesting examples of engineering ingenuity and skill.

As an illustration, I will give a brief description of some improvements now being made in the Pleasant Valley and Lake Canal, which, although not large or costly will serve as a type.

This canal was originally designed to water a small valley, situated on the bank of the Poudre River, and between the last two ranges of foothills which skirt the Eastern base of the Rocky Mountains. Afterwards the canal was enlarged and extended to pass, by means of a flume, through the opening in the foothills made by the river, out on the plains, and made to water the country which immediately borders them, but which owing to the rapid slope of the country to the East, is too elevated to be watered by canals taken out of the river, below the foothills. The flume was built along the almost perpendicular face of a cliff, and was about fifty feet above the bed of the river. It was supported in part by a shelf blasted out of the face of the rock, and in part by trestle work and the canal leading to this extended nearly a mile along the inner side of the hill, after leaving the valley, and passed back on the outer side an equal distance before reaching the point of its distribution.

Owing to the temporary character of its construction, the flume and its approaches furnished a very precarious means of supply to those living on the plains, while constantly subjecting its owners to bills for repairs, and last autumn a survey was begun of a tunnel to pass through the hill at the point where the canal reaches it from above, thus shortening the canal nearly two miles, and rendering the fall thus gained available for other purposes. Work was begun at both ends of the tunnel last October, and it is now about two-thirds completed. It is 1550 feet long, has approaches of 250 feet, making a total length of 1800 feet. The extreme dimensions of its cross section are 6 by 6 feet, and its total fall 3 feet. Owing to the solid character of the rock, no shoring or other supports were necessary, except between stations 15 and 16 where a layer of clay was found.

As the outlet of the tunnel was considerably above the level of the canal, advantage was taken of this to convert a lake, lying at the base of the hill, into a storage reservoir. This lake lies above the irrigating canal proper, has a superficial area of between 90 and 100 acres and by means of an embankment across one side, will have an available depth of sixteen feet. It has been so arranged that the water can be turned directly from the tunnel into this reservoir, or pass through a canal built along the embankment and made to irrigate land on a still higher level.

The connection between the storage reservoir and the irrigating canal proper is by means of three iron pipes 14 inches in diameter, set in a masonry tunnel which passes through the embankment. These pipes are opened and closed by means of valves connected by iron rods with screws in the top of the frames. As the pressure of a column of water of the depth of the reservoir would subject these valves to a heavy strain, as well as render their working difficult, a projecting set of wooden gates have been built in front of them, which can be raised and removed in sections, thus drawing off successive layers from the top of the reservoir.

As a protection from waves the inner sides of the embankment have been covered with riprap, while the inroads of vermin have been guarded against, by placing a row of firmly braced posts through the center, and nailing to these a solid wall of 3 inch spruce plank.

The entire cost of the work when completed will be about $22,000.

THE PANAMA CANAL.

THE MORTALITY RECORD.

"Our $20,000,000 has been spent in establishing homes for the engineers and workingmen along the route of the Panama Ship Canal," said Capt. James Wiltbank, who has been for more than a year engaged in dredging operations on the canal, and who has just returned home after a tough tussle with the dreaded swamp fever.

"Plenty of money there, Captain?"

"Oh, plenty. There is only one thing more common than cash, and that is death. Men die like the leaves in autumn. Only the Italians appear to live. The dead are disposed of without ceremony. A shallow grave, no prayers, and all is in a moment forgotten. There are now 15,000 men at work on the canal, mostly negroes from Jamaica and the French West Indies. These negroes are brought over in droves as fast as those at work die, and I venture to say that not two-thirds of the 15,000 laborers now at work will be alive a year from now. It's dreadful. Five thousand died during the past three months; but the large pay tempts men to brave all the danger. The company appears to have an unlimited supply of money and pays off every two weeks."

"What progress has been made in the four years?"

"Well, two miles and a half of the canal proper has been dug out. Originally this section was dredged to a depth of fourteen feet, but is now only six feet deep, the soft swamp lands pressed down by the weight of the dirt thrown out on either side filling in the canal from underneath. A great deal of work has, however, been done with the great steam shovels in levelling the high lands through which the canal is to pass, and dredging will soon be started in those sections. Work is now progressing upon the only large mountain which bars the way of the canal from ocean to ocean. This mountain is 400 feet high, and nine miles in circumference, and is to be cut down with steam plows and carted away. The company has been compelled to spend $20,000,000, as I said, to locate homes through the swamps from which as a basis the work of digging out the canal can be carried on. This work necessitated the building of railroad branches into the swamps, and the making of solid foundations with stone and gravel, hundreds of feet wide and miles in extent Laborers get $3 a day, and skilled mechanics and bosses from $100 to $350 a month."

"Will the canal ever be finished?"

"Not, I think, unless the swamp sections are constructed with piling, and that would cost so large an amount of money that the scheme could not possibly pay. But the company appears to have all the cash necessary to carry on the work."—*Philadelphia Record.*

Aqueducts on High Embankments.

Written for Engineering News.

BY DESMOND FITZGERALD, C. E., SUPT. WESTERN DIV., BOSTON WATER WORKS.

Where the grade line ran above the surface of the ground, the Cochituate Aqueduct was built on puddled embankments without any other foundation than that offered by the earth filling. The wisdom of this course will hardly be doubted after the experience with the Sudbury Aqueduct where a similar method was pursued, and with the Croton, where an inferior quality of masonry was used with rather poor results.

The highest embankment on the Cochituate is situated at Newton Lower Falls on the banks of the Charles river.

The height is 40 feet to the finished grade. The thickness of the masonry is eight inches, or two rings of brick which would hardly be considered a sufficient section at the present day.

The aqueduct was built in the embankment without any extra precautions to prevent leakage from the interior.

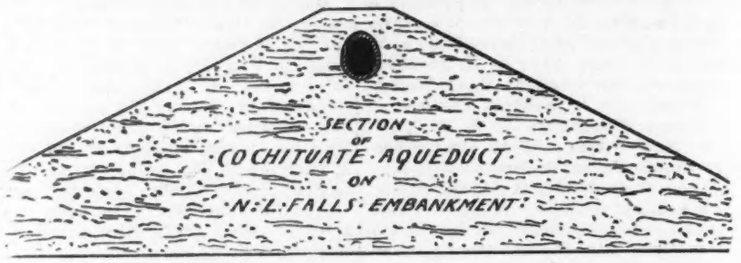
The stability of a structure of this size, with so small a section, is not such as to withstand the pressures or shocks to which masonry conduits are too often exposed. The consequence in the Cochituate has been, that large cracks appeared early in its history, and especially on embankments. These grew constantly worse, notwithstanding pointings, until, as in the case of the embankment at Newton Lower Falls, the safety of the structure was imperilled. The repairs, for a number of years, were necessarily very hastily made. At first the bottom was stopped with wooden wedges, then slates were covered over the cracks and embedded in cement and afterwards heavy linings of Portland cement were added. As the water escaped through the bottom, the invert opened and settled, and the crown came down in some cases four inches, and of course the sides bulged out something more than a corresponding amount. The original section was 6 ft. 4″ x 5 ft.; this became 6 ft. x 5 ft. 6″. A few years ago, the writer found quite extensive spaces under the aqueduct and running up on its sides, and it was evident, either that a new aqueduct would have to be built at this point or the old one repaired in a thorough manner. Water would sometimes appear on the sides of the bank but never to any considerable amount. In one case, the brickwork was stripped directly over a leak, and a cavity in the earth filling was found next to the crack. A concrete buttress was put in as a temporary expedient which answered the purpose.

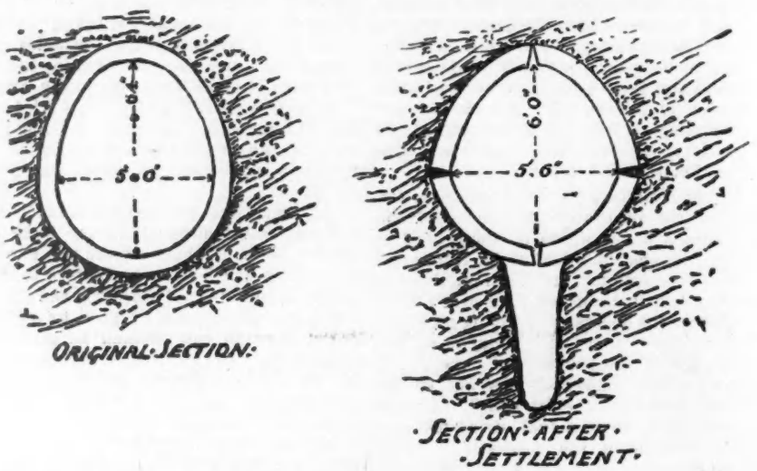
In February, 1882, an opportunity was offered for the thorough overhauling of the masonry and a gang of men were started on the portion under discussion.

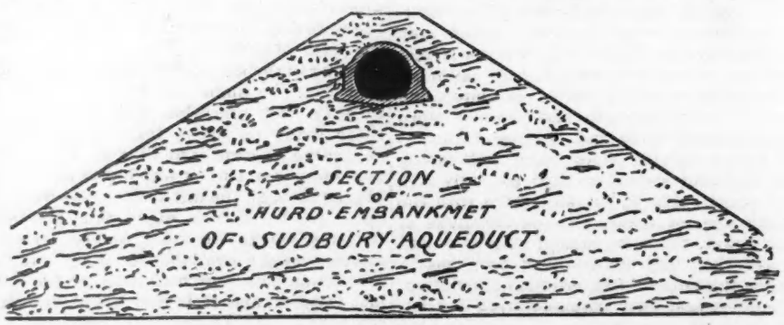
In the first place, holes were cut in the bottom and sides for the purpose of ascertaining the actual condition of affairs. The cavity began on the North side of the embankment and at a height of 3½ feet above the invert, thence extended diagonally downwards in an Easterly direction until it reached the center under the invert which it then followed for a distance of about 100 feet, extending to a depth of 4½ feet, and averaging from 18 inches to 2 feet in width. The following middle diagram will show the situation.

Short sections of the bottom were then cut entirely out. If too great a length had been thus exposed, the tendency would have been for the sides to press in towards the centre. The cavity under the aqueduct was then filled with concrete and the invert rebuilt in its original form of new bricks thoroughly laid in cement. The cracks in the sides were then cut out, explored to their full depth and pointed with cement mortar rammed in with tools. In some places as many as twenty courses of bricks had to be cut out. The interior was then given a half-inch coating of Portland cement rubbed down to a polished surface. Memoranda of heights and widths taken after the work was done and compared with recent measurements show no change of form since the completion of the undertaking, neither does the lining show the slightest crack. It is thought that the brick work is now in a permanent condition unless the structure should be subjected to improper strains.

Repairs of this nature require great patience and the constant oversight of a conscientious inspector.







A section of the highest embankment on the Sudbury Aqueduct is herewith given.

The height is 50 feet from the old surface of the ground to the finished grade. The gravel was deposited in layers, kept thoroughly wet and rolled with heavy grooved road rollers. Before the masonry was laid the embankment was loaded above the grade line of the aqueduct with enough material to equal the full permanent load. The gravel was then excavated for the masonry structure and the back filling replaced. It was expected that there would be settlement of about ¾ of an inch, and allowance was made in fixing the level of the aqueduct. In other words, the aqueduct was built ¾ of an inch high in the centre of the embankment.

Levels taken last year, under the direction of the writer, showed that the maximum settlement had not exceeded the ¾ of an inch, and it amounted to just this amount for a very short distance. Not the slightest disturbance of the masonry could be detected.

The weight of this evidence goes to show that if proper care is used in the building of an embankment its total settlement can be calculated with as much dependence as a good class of masonry. From the experience with the Cochituate Aqueduct it is shown that the section of masonry in an embankment should be one of good stability and even of extra strength, and that care should be exercised to insure the tightness of the work against the interior pressure.

Examination of the Thayer School of Civil Engineering.

HANOVER, N. H., April 23, 1884.—The annual examinations of the Thayer school of civil engineering took place to-day. The graduating theses were: "Examination of the water power at Olcott falls and the works of its utilization," George H. Hutchinson, B. S., Norwich, Vt.; "Review of the Sanitary Condition of the village of Hanover, with Suggestions for the Future," George Riedemann, B. S. New York. Board of examination: President Bartlett, Prof. Fletcher, Prof. Hardy, Prof. Bartlett, and Mr. H. A. Hitchcock, C. E. The board of overseers was represented by Prof. O. P. Hubbard of New York, Prof. George L. Andrews and Prof. P. S. Michie of West Point. The faculty of Dartmouth College have appointed as librarians for next year from '85: George H. Whitcomb, S. H. Hudson, F. W. Clapp; '86, H. P Anderson.

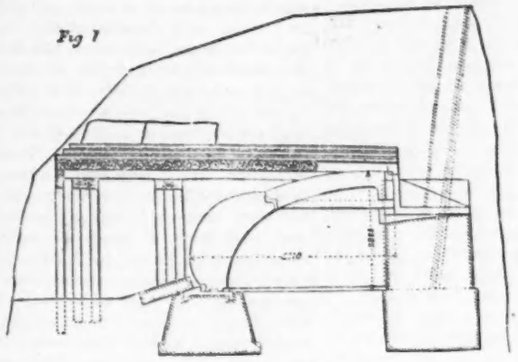


Fig 1

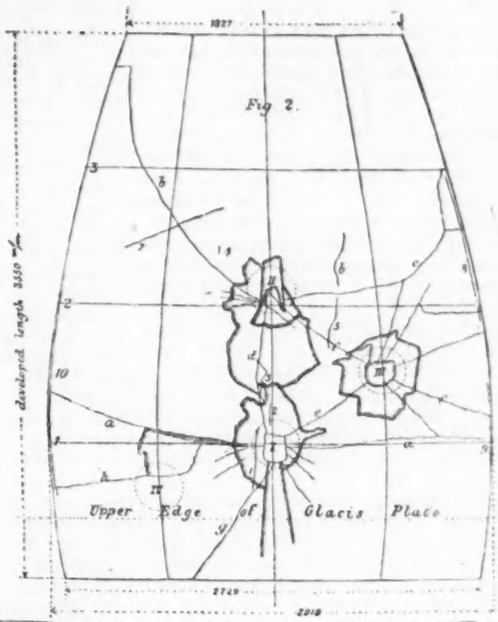


Fig 2.

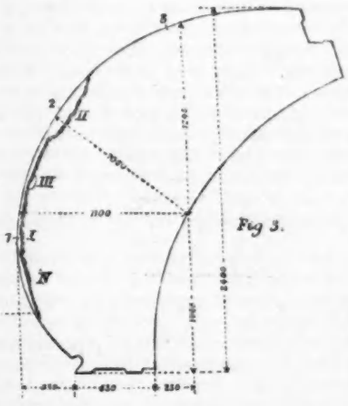


Fig 3.

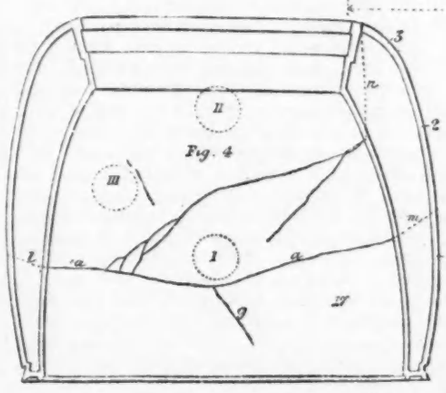


Fig. 4

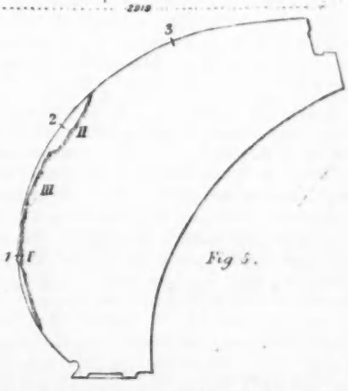


Fig 5.

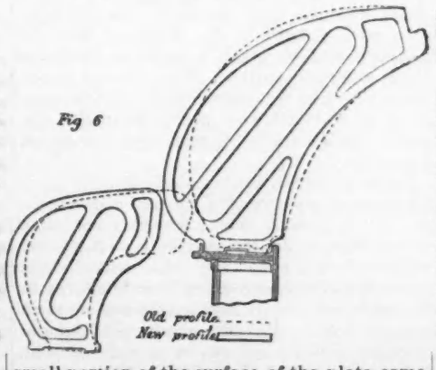


Fig 6

Experiments on Cast-iron Armor.

The experiments recently carried out at Mr. Gruson's polygon at Buckau, Magdeburg, when a "side" plate of chilled cast-iron, forming part of a turret for two 12 in. guns ordered by the Dutch Government, was submitted to the attack of a 12 in. B.L.R. Krupp gun, have an important bearing on the question of armor for coast defence.

The target consisted of a "side" plate, as before mentioned, weighing about 46¾ tons, on each side of which two other "side" plates were fixed with a cover plate on top, forming together half a turret, supported at the back or open side by iron plates resting against three solid masonry pillars (Fig. 1).

The gun used was the Krupp 25 calibre long 12 in. B.L.R., firing hardened steel projectiles, 3½ calibres in length, of 980 lb. weight, with a charge of 264 lb. of prismatic powder; distance of the plate, 27 yards, velocity of impact, 1460 f.s., energy of impact 14,498 foot tons.

Four rounds were fired, of which the following are briefly the results:

Round No. 1 struck 2 in. from the vertical centre line and 3 ft. from the base of the plate, forming a horizontal crack reaching to each edge of the plate (*a* in Fig. 2). To the left of the point of impact and along the crack the surface of the plate was chipped off 1 in. broad and 12 in. long, and round the point of impact about the same length, 12 in. in breadth, and 1 in. deep.

The point of the projectile, which was of exceedingly hard and tough metal, splashed on the surface of the plate in the shape of a flat disc, without penetrating, forming only a slight depression, and so firmly adhered to the chilled iron that when forcibly removed a small portion of the surface of the plate came with it.

On an examination of the general structure it was found that the top plate had been driven back about one-third of an inch on the right and one inch on the left; a movement had taken place in the iron supports in rear, from which it was evident that the masonry pillars were not strong enough to resist the push of the half-turret, and consequently there had been a slight displacement of the position of the supporting side plates.

Round No. 2 struck as shown in Fig. 2, 3 ft. 3 in. above No. 1, producing cracks *b*, *c*, and *d*, on the front of the plate, which were, however, not visible in rear. A further movement of the interior supports was noticed.

Round No. 3 struck to the right about 3 ft. from rounds 1 and 2, forming cracks *e* and *f*, on the front of the plate. The effect of rounds 2 and 3 on the surface of the plate is shown in Fig. 5. Fig. 4 illustrates the appearance of the back of the plate at this stage. The left hand masonry pillar was found to have moved, thereby causing the parts of the half-turret to lose their mutual support.

Round No. 4 struck low on the left and broke up the plate into six parts, driving that portion between cracks *g* and *h*, Fig. 2, to the rear, the parts on top falling together and closing the breach. It appears from this that in the first three rounds the plates supported an impact of 43,494 foot-tons, or 930 foot-tons per ton of plate, and fully preserved during three rounds the protection afforded to the interior of the turret. The only injury to the surface of the plate were indentations 1 in. to 2 in. deep. In no case had the projectiles or their points penetrated into the plate.

There can be no doubt that the breach made in the plate at the fourth round was greatly influenced by the insufficient strength and consequent movement of the supports in rear, thereby causing a general dislocation of the structure, breaking the joints between the plates and causing them to lose their great mutual support, arising from their arch-like disposition. Had a whole turret been erected on its wrought-iron substructure for experiment, greater solidity, elasticity, and mutual support would have been obtained. Instead of the displacement of the plates caused by the movement of the supports and masonry pillars, a complete turret would have exhibited vibrations and small elastic movements, which would not have caused the joints to open, as was the case in the experiment, thus facilitating the formation of cracks and ultimate breaching of the plate.

As the fundamental point necessary for the success of chilled iron armor depends upon the mass of the whole structure, it will be seen at once how large an element in the total re-

sistance the arch form of the complete turrret is.

There is, however, no need to seek to minimize the fact of the breaching of the plate at the fourth round. The general behavior of the armor may justly be considered excellent, especially in view of recent experiments with compound armor. Even under disadvantageous conditions we find that three rounds fired in a manner highly improbable to occur in war, were effectually kept out and the integrity of the defence absolutely preserved.

Armor, of whatever description, must suffer from the blows of the commanding artillery of the present age. What, it may be asked, would be the effect of firing four such rounds at a compound armor structure, concentrating them on a superficial area, 4 ft. 6 in. by 4 ft. 3 in ? What would be the extent of the injury ?

Up to the present, chilled iron has not been attacked by the larger modern guns, and this trial, whilst confirming Mr. Gruson in the correctness of the general principle of his armor, affords him valuable data for his future constructions. It has shown the value, already anticipated, of proceeding to larger weights in the individual parts of the turret, and of devising means for insuring intimate mutual support so as to better distribute and absorb the blows of shot; in addition to which the general form of the plate will be modified, so as to give greater thickness to those parts which the recent trial has shown require it. These modifications are seen in Fig 6.

It is important to notice that the projectiles used in these trials were Krupp's newest design of forged steel shell, possessing extraordinary toughness and elasticity, and from their strength giving out on impact a much larger proportion of their energy than other kinds of shot. These projectiles absolutely failed to get even their points into the chilled iron, and on impact shivered into atoms, hardly one piece remaining of the size of a man's fist. They are the same shell, which when fired from an 11-in. gun, perforated a 15-in. wrought-iron plate with hardly perceptible change of form. No such projectiles have as yet been used in England against compound plates.

These trials have been referred to in recent articles as if their object had been to show that the plate was capable of withstanding the continued attack of the 12-in. gun. Such was not their aim, which was to ascertain whether the surface flaws which occasionally occur in the castings were detrimental to the structure of the plate or would influence the formation of fissures caused by battering. For this purpose it was evidently necessary to expose the plate to a fire which would fissure it. The immediate object of the trial was satisfactorily determined by the fact that none of the cracks in the plate originated in a surface flaw.

So far from Mr. Gruson being surprised at the result, he was not alone in thinking that with regard to the dimensions of the plate and the test it was put to, it came very well out of the trial. The yielding of the supports influenced the result just as unfavorably as was the case with the compound plates at Spezia, even more so, in fact, owing to the special properties of chilled iron armor. Had the plate been supported by such a massive and costly structure as that on which the compound plates rested at Shoeburyness, and to which their resistance—so far beyond the expectations even of the advocates of compound armor—was mainly attributed, no doubt the chilled armor would have given corresponding results. In fact, the plate at Buckau was too small to withstand a prolonged attack from the 12-in. gun at short range, and owing to the supports yielding it became isolated, and consequently succumbed at the fourth round. Had it formed part of a complete turret, or had the supports been sufficiently rigid, no doubt it would have withstood many more rounds.—*Engineering.*

The Water Supply of London.

The discussion on General Rundall's paper on "A System of National Water Regulation," which was read at a meeting of the Society of Arts on March 12th., was opened by Sir Robert Rawlinson, C. B., who spoke as follows:—Mr. Ruskin some time since recommended compensating reservoirs to regulate the floods in Italian rivers; but if he knew as much about floods as he said he knew about pictures, he would never have hazarded any such remarks. Reservoirs might be made for any purpose, and he did not disparage them for the purpose of canals or water supply, but as to making compensation reservoirs to regulate or diminish river floods, all the capital in the country would not do it. Such reservoirs must be either full or empty; if they were full they would be of no use, as they would hold no more water and if they were empty, probably two days very heavy rain would fill them. In a small area he had under his own control, where the dry-weather flow was about 250,000 gallons per day for months continuously, the flood flow was in one day upwards of 90,000,000 gallons. What size, then, must be the compensating reservoirs for such a district? Where would you find the sites or the money necessary to make compensating reservoirs for the Thames? Last week he went down to inspect the water supply recently formed for the town of Leeds; not quite finished. The reservoirs were about the finest he had ever seen; they were in the valley of the Wharfe, three in number, one below the other; they cost from 150,000*l*. to 200,000*l*. each, and were capable of impounding 20,000,000 gallons per day. Out of that they were obliged to send 6,000.000 for compensation, leaving 14,000,000 for Leeds, and at one point they had pumping power by which they could raise 6,000,000 more if required. These works, with the necessary distributing apparatus, had cost some 1,500,000*l*., the population being about 320,000 or about 5*l* per head. The metropolitan water supply took each day about 150,000,000 gallons of water from the Thames, the Lea, and the chalk springs, equal to about one-third the dry-weather flow of the Thames; but the quantity actually taken from that river was about 80,000,000 gallons. The various works were valued by Mr. Smith for the late Government at 33,000,000*l* but the present Government repudiated the bargain, and denounced it as a job.

As an engineer, having some knowledge of the value of water-works, he said it was not a job; he believed it was as honest a valuation as ever was made, by as able a man as ever undertook such a task, and that London would never again have so good a bargain offered it. He made this remark because the subject must come up again. He quite agreed with General Rundall, that the utilization of water should, in many respects, be both national and municipal. Water should not be dealt with like sugar, butter or beer; it should not be dealt out so as to produce the largest dividend, but should be so stored that it could be utilized by the community at the cheapest cost, and that all surplus might be used for public purposes at prime cost. Dwellers in London knew what a condition the streets and footways were in after two or three small falls of rain; but if the water supply were in the hands of the municipality, every public footway might be washed with water, not costing more than ½*d*. per 1,000 gallons, instead of 6*d*. or 8*d*., as was charged by the companies now; and they would then be made as clean as they were after a heavy thunderstorm, every week, and every day, if necessary. All the great municipal bodies were acquiring the water supply in the same way as London would have to do, if any municipal body were established which could have the control of it. They would have to pay a fair and honest price for it, not a confiscating price. That price would necessarily be large, but it would not be dear, if in future they had no more dividends to pay, but only the interest on the capital, which a community like London could borrow at 3½ per cent. The companies were now paying 8, 10 and 12 per cent., hence the great value they put on their works; and as the works extended, that interest went on in the same ratio on a larger capital. If the municipality had the works, they would only have to pay the cost of management, and by consolidation from 50,000*l*. to 100,000*l*. a year might be saved in management. It was just the same with regard to gas. Manchester, Birmingham and Leeds had acquired the gas. Leeds gave a large price for the existing works, but they now supplied gas 1*s*. 10*d*. per 1,000 feet, and made a surplus. In Birmingham there was not a man in the Corporation who dared to face the large expenditure involved in purchasing the water and gas works until Mr. Chamberlain became mayor, the idea being that it would saddle the town with an enormous debt, forgetting that when you bought a paying property you were not incurring a debt, but acquiring an estate. In 1852, he valued the Birmingham Waterworks, and they could then have been bought for some 350,000*l*.; but they were afraid of it. When Mr. Chamberlain became mayor, he showed them that they had been losing about 7,000*l*. a year by not having bought them, and they then gave some 1,250,000*l*. They had been considerably enlarged, the result being that the water was cheaper and better in quality, and was distributed over a wider area, and produced an income which more than paid the interest on the capital and maintained the works in efficiency.

PUBLIC WORKS OF PHILADELPHIA.

Water Supply.—The water supply of the city is of such importance that earnest and speedy attention should be given to the completion of the reservoirs now in course of construction, the increased capacity of the distributing mains, and the general improvement of the defects of the old system, resulting as they have from past negligences, as will permit the present able and efficient head of the department the opportunity to evidence the skill and ability in which he so clearly combines the science of the engineer, and the zeal of a most anxious, intelligent and conscientious public servant. Councils cannot too strongly aid in the fulfilment of his plans and consequent improvement of the system which he may perfect.

Highways.—The condition of the highways demands a most liberal consideration, both as regards the modes to be adopted and the amounts to be expended. I would suggest a few general thoughts, which may find some response in your own impressions:

First—That a liberal sum be appropriated each year for the substitution of Belgian or other improved pavement for the present cobble-stone streets. The Board of Experts recently appointed by action of your bodies, will aid you in determining what is best for each class of streets.

Second—That improvements thus inaugurated must be carried forward continuously and systematically throughout the principal arteries of travel, and should not be scattered—a square here and there, without direct connection.

Third—That the city should contract, if necessary, for the materials needed, to be delivered at such wharves in the city as may from time to time be required.

Fourth—The city should pay cash for all contract work, and make the assessment bills payable to the City Treasurer. The present system costs the city about 10 per cent for collecting these bills.

Fifth—Contracts should not invariably be given to the lowest bidder, who often is irresponsible, and not the one best calculated to give satisfaction.

Street Cleaning.—Contracts for street cleaning should be made for a term of years. If this be impracticable, separate contracts should be made to transport by rail and water all street dirt, garbage, etc. The deposit of such material at the various dumping grounds within the city limits, is not only prejudicial to health, but is impracticable in wet seasons. The use of railroad facilities would enable even liquid materials to be hauled and loaded into cars, when it would be impossible for cars to reach the dumping places.

Sewers.—The revision of the present system of sewers demands your earnest consideration of such measures as will reduce the danger at present experienced to the health of the citizens in so many sections of the city. The present piecemeal system of construction, one square now and another then, should be abandoned. Councils have taken a wise step forward by authorizing thorough inspection, and in order to carry out a sewer plan systematically they should designate certain territory to be *completely sewered*, and thus proceed, year after year, until a good system is secured.

Railroads.—Rapid transit in some form is indispensable in all large communities, and the damage to life and property by grade crossings is so great as to make the bridging of streets on steam railroads a necessity. Grade crossings within our corporate limits can now be counted by hundreds, and the protection of the community demands safe bridges. When a road is once constructed with street crossings at grade, the change involves a great additional outlay, not only for the structure, but for damages for changes of grade. If a new railroad is projected with a view of dispensing with grade crossings the cost of bridging is greatly increased, and as the city has to bear the greatest part of the burden, it would seem that no railroad should be allowed to force these extraordinary expenditures for bridging on the city. Hereafter no railroad should be built in the corporate limits without the city having a voice in adjusting the lines and grades, so as to conform as far as practicable to such street elevations, as will admit of passing under or over the tracks of the steam road.—*"From Mayor Smith's Inaugural Address Apr. 7."*

Construction of Steam Boilers.

At the meeting of the Engineers' Society of Western Pennsylvania, held in Pittsburg, Tuesday evening, the 15th ult. Mr. George P. Burwell, of the Hartford Insurance Company, read a paper on the construction of boilers and the generation of steam. He treated first the composition of the steel of which the boiler plates are made, and the manner of construction in a boiler.

In speaking of the two-flued boilers, he said that you might as well try to convince a Pittsburger that a basswood chip would make a circular saw, as to tell him that a rolling mill can be run with any other kind than a two-flued boiler. "In 17 years," continued the gentleman, "we have had but one single explosion in the Cleveland district over which the society to which I belong controls. You can't get it out of some engineers' heads that a drum is not necessary to some boilers. They will admit that a small drum can be done without, but not a large one. If the cubic capacity of the tubular part is increased to that of the boiler with one drum included, you will not need a drum."

After the gentleman finished reading the paper, he exhibited two drawings of boilers, in one of which there were 120 two-inch tubes, while the other represented a boiler of the same size in which there were 48 four-inch tubes.

The speaker claimed an advantage for the large tubes, as it gave you more space for water, and there was not so much danger in admitting cold water. He also claimed that the small tube boiler would generate steam faster than the other, but the large tube boiler would not exhaust as soon as the others. In speaking of the locomotive boiler, he said:

"As is well known the firebox is the weakest part, except the throat-sheet, and should be well protected. The cause of the explosion on the Fort Wayne road was an organic weakness in the throat sheet. The boiler was made in 1880. A crack was discovered in the throat sheet shortly after the engine was turned out, over which a copper patch was placed, which stopped the leaking, and to the engineers meant nothing. When the leak was stopped, the crack was 28 inches wide. Now we take the position that there can be no explosion unless a rupture occurs. In this case, the sudden generation of steam increased the bulk of steam 1,700 times and caused the explosion. Now it is a natural law that steam always follows the course of the weakest part, and naturally it came back through the firebox, causing what is called a collapsed explosion.

"The steam went downward, tore up the track and upward into the cab. It completely turned the engine around and blew the engineer and fireman forward in the same direction the train was going. Now, to whom does the responsibility belong for this explosion? To the advocates of the low water theory?" Several members propounded questions which were promptly and, seemingly, satisfactorily answered. Superintendent Brown, of the Pittsburg water-works, had a lively little tilt with Mr. Burwell, which afforded a great deal of amusement.

Past President Wm. Metcalf, of Miller, Metcal & Parkin, said he was very much interested in the paper and had learned many startling things. "But," said Mr. Metcalf, "I have had some experience with steel, and have seen some wonderful tests, and when the gentleman states that a low tensile strength steel is the best, I have to take issue with him."

Mr. Jones, of the Edgar Thomson Bessemer Steel Work, said: "I agree with Mr. Burwell in the main points, and, like him, I prefer the sixty thousandth tensile steel to the sixty-five, and while Mr. Metcalf is a manufacturer of excellent steel, the kind he manufactures is rarely used in boiler plates. While I admire the Pennsylvania Railroad Company for the excellent talent they employ, yet it is not long since that they wanted to force down our throat that the soft steel was the best. They insisted on soft steel axles and tires, but they are gradually coming around to the popular belief that soft steel is not the best in all cases."

A Cuban Contract for Phœnixville.

The Phœnix Bridge Company, which succeed the old and well-known firm of Clarke, Reeves & Co., have secured, through their agent, Thomas L. Reakirt, of 218½ Walnut street, Philadelphia, who has just returned from Cuba, a contract for four new iron piers to be erected in the port of Havana, which will add greatly to the convenience of all concerned in the trade with Cuba. These piers will each be 350 feet long and 40 feet wide, and will be constructed in the most substantial and durable manner. They will be the first long piers ever built in that port. Heretofore all vessels landing at Havana have been compelled to anchor in the bay and land their passengers by means of small boats and discharge their cargoes in lighters. These piers will allow all vessels to land passengers and freight direct, as at this and other ports. The piers will be built entirely of iron, and, instead of resting on wooden piles, will be built on the well-known Phœnix iron columns, forced into the bottom of the bay. They will be located at a point where there is plenty of water to accomodate any vessel now afloat, and will adjoin large warehouses, whereby every facility will be afforded for the prompt handling and care of cargoes. Mr. Reakirt will return to Cuba shortly with the necessary machinery and mechanics to complete the work, and the piers will be ready for use by the early part of the coming autumn.

SELECTED MISCELLANY.

ACCORDING to Prof. Wanklyn the manufacture of gas from limed coal is a success, as it reduces the amount of sulphur compounds to three grains in the hundred cubic feet, and increases the yield of ammonia and tar by the abolition of the lime purifiers.

AN iron company, whose headquarters are in Pittsburg, has just realized $57,000 in spot cash by the sale of trees growing on its mineral lands in the Lake Superior region, being at the rate of $3.50 per 1000 feet of "stumpage."

TABULATED results of 250 experiments with 42 distinct explosive compounds were published in March by MM. Berthelot and Vieille of the Academy of Sciences, Paris, bearing on the amount of pressure developed at the moment of explosion, the temperature produced, and the specific heats of the gases, especially those of the compound ones, at various temperatures.

A NUMBER of petitions have been received by the House Committee on Patents protesting against any reduction of the lifetime of patents. Members of the Committee say the petition must be due to a misapprehension on the part of the inventors of the country, as the committee has unanimously reported adversely on a bill reducing the lifetime of patents.

To obviate "kinks" in submarine telegraph cables, and consequently render these important means of communication less liable to break when subjected to a strain, Messrs. Trott and Hamilton have adopted the expedient of making each alternate layer of sheathing cross each other. Thus if the inner sheathing of hemp has a right-hand "lay," care is taken that the lay of the next sheathing shall be left-handed.

ACCORDING to the last census the total area of the United States and the territories, not including Alaska, is 2,970,000 miles. Of the states, Texas has the area, 262,290 square miles, and Rhode Island the smallest, 1085 square miles, so that the former would make 241 of the latter, and have 805 square miles over. But Rhode Island is ahead of all others in density of population, having 254 persons to the square mile.

A PECULIAR kind of building stone is found in some localities in Oregon, having the property of being uninjured by cold, heat, or moisture. It is called granite sandstone, is very rich in silica, of a close, fine grain, highly crystalized, unlaminated, and of a fine brown color. On being brought to a white heat, and suddenly plunged in cold water, it comes out as solid and firm as at first.

THERE are in France 4575 miles of navigable rivers, as against 4,190 miles in 1852, and there are also 2,900 miles of canals, as against 2,440 miles in 1852. This shows an increase in rivers of 385 miles and in canals an increase of 460 miles. But the increases were enormously expensive. Between 1852 and 1878 the outlay for them was nearly $70,000,000, and since 1878 it has been about $55,000,000 additional. Meanwhile the quantity of freight carried by water has increased only 4,000,000 tons.

THE French commission appointed to consider the practicability of cutting the Isthmus of Kraw for the proposed Malayan canal have completed their survey. The report asserts that the cutting of a maritime canal on the level through that isthmus will present no considerable obstacles. The isthmus is described as being covered with valuable timber; the lower stratum of the ground is granitic, and the upper is generally a soft sandstone.

IN boring for water near Snake River, about forty-five miles from Dayton, Or., recently, a stratum of frozen earth was encountered at a depth of fiftyfive feet. Passing through this for five feet, numerous cavities were found, from which cold air came in gusts. The escaping air at the bottom of the well can be heard roaring at some distance. It is not possible for any one to hold his hand over the well for any length of time without freezing it, and a bucket of water let down into the well was frozen over in a few minutes. Work on the well has been abandoned on account of the cold.

A CORRESPONDENT of the Boston Journal writes from Bartlett, N. H., that 97 inches of snow fell in that place in January, 24½ in February, 32 in March, and 7½ inches on April 2, making by actual measurement a total for the winter of 8 feet 5 inches. During February there were three rain storms amounting to 13-16 of an inch, and one storm of hail, making 2½ inches. During March there fell 11-16 of an inch of rain and ⅞ of an inch of sleet.

IT is is estimated that in order to comfortably shelter the poor of London 80,000 rooms would have to be built at a cost of $35,000,000. The money could probably be got, but the great difficulty would probably be the procuring of sites close to the work of the laboring classes, or, in other words, in the localities which they now inhabit. House property in London has so much increased in value that the average rent per house and per inhabitant has more than doubled since 1831, and at the present time the rental of the great metropolis is increasing at the rate of one million sterling per annum.

Engineering News

AND

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CORRECTIONS.—In paper upon "*Special Appliances for Fire Protection*" read at the Water-works Meeting 3d, 13th and 17th lines from bottom of first column read "steamer" in place of streams. 5th line from bottom of same column insert "minutes" after the word twenty. And in second column read: "It is a reservoir the Water-works' Engineer did not locate and one having a capacity that he did not figure out."

ONE of the conundrums of our customs laws that we would like to have solved, is why duty is charged by the U. S. authorities, upon the Proceedings of the Institution of Civil Engineers, sent to members of the Institution in this country. These Proceedings are new books in one sense of the word, but they are not articles of traffic; they *cannot* be bought. They are issued only to members of the Institution for their personal use.

One of the most curious features in the affair is that in the shape of separate papers sent through the mail, they come duty free; but when the Proceedings for six months are stitched together in book form, the same post-office charges custom's fee. Why is this?

WHILE the detailed programme of the Buffalo Convention of the American Society of Civil Engineers, is not yet published, the indications point to a gathering of more than usual interest.

Letters have been received from the Mayor of Buffalo and from the Presidents of the City Council and the Board of Trade, assuring the Society of a cordial welcome. The location is a central one and the attendance should be correspondingly great, and from hints dropped by the committee of arrangements, we are assured that the general bill-of-fare will be palatable.

WE would repeat our advice to the members of the Society, to attend the Convention, at any sacrifice of other summer schemes or home work. It is good for all men to alternate work with recreation, and it is especially well for the civil engineer to break the monotony of his daily plodding, when he can do this with pleasure to himself and professional profit, when he can visit new scenes, examine new works, and compare notes with new men.

ENGINEERS are members of one of the most rapidly advancing of professions, and vigorous exertion is required to keep pace with the procession. For this reason, among others, no engineer can afford to stay at home altogether; if he does, he will surely fall into a rut, which will deepen until escape is impossible.

One of the best methods of obliterating professional ruts is to cross it with others, until by their frequent intersection the general surface is made smooth. Engineers, to progress, must compare their experience with other engineers; weigh their results by the results of other methods, hear the men of broader experience relate their trials and their triumphs. When this is done who can doubt the general gain?

THIS meeting of men and this personal contrasting of methods is the chief end of these annual meetings of the American Society of Civil Engineers, and every branch of the profession, and every section of the country should be ably represented. A more lively interest is awakened in the success of the society, and its field of usefulness is widened. And this extension should only cease when every worthy member of the profession is enrolled upon its lists, and continue until its endorsements is a requisite for all professional engagements.

The Phœnix Bridge Company.

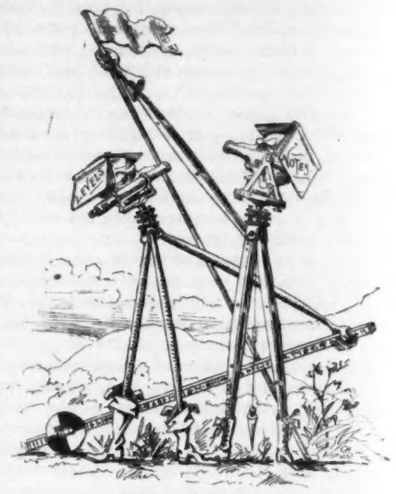
The announcement is made of the dissolution by mutual consent, of the co-partnership of Clarke Reeves & Co., forming the firm of the "Phœnixville Bridge Co.," and the formation of a corporation under the name of the "Phœnix Bridge Company," which proposes to carry on the business heretofore conducted by the first named firm.

The principal officers of the new company are all members of the old and well known firm, the name of Mr. Clarke alone being missing. The engineering offices, shops and works are at Phœnixville, Pa., as they have always been, and the Philadelphia and New York offices remain unchanged.

The new company inherits in full all the peculiar and exceptional advantages of the old firm. It is located with, and intimately connected with the extensive works of the Phœnix Iron Co., all material used by it in construction is manufactured on the premises, from the ore to the finished parts ready for erecting; and with this company goes the prestige of the vast amount of work which has left these shops in the last fifteen years. This record of work done foots up to about sixty miles of iron bridge-spans, scattered over the principal railroads of the United States and Canada, and includes in the list, the famous Kinzua Viaduct, from plans of the present Chief Engineer, Mr. Bonzano, and the Elevated Railway structures on 8th, 9th and 2d Avenues in the City of New York.

MARBLEHEAD, Framingham, Winthrop and Andover, all in Massachusetts, are applying for permission to have a public water supply. The proposed expenditures for the first two are $200,000, and $250,000.

THE Two-Dollar Edition of Baldwin Latham's *Sanitary Engineering* is selling rapidly.



RECRIMINATION.

THE LEVEL.

Says the Level to the Transit:
"Don't you think that you can prance it
Over mountain, field and valley
With your chain and painted flag?
Don't you think you go a jumpin' ?
That you keep me just a humpin'
With my plus and minus countin',
You condemned old brag!"

THE TRANSIT.

Says the Transit to the Level:
"You may go unto the——!
You're no good at all for running
Over hill and valley broad.
I can leave you, by the hokey,
You old everlasting pokey,
With your hundreths and your thousandths
And your twelve foot rod!"

THE LEVEL.

"Now you'd better just believe me,
You can never, never leave me,
For I'll hang on to your coat-tails
Like your sweetheart's father's dog.
You kick up an awful rumpus
With your plumb-bob and your compass——
You three-legged pile of scrap-iron,
You old two-toothed cog!"

THE TRANSIT.

"Draw it milder on your blowing!
You had better quit your crowing
Till we get the other side of
Laurel Hill and Horner's Run.
May I never set a plug
If I don't give you such a tug
As I'll make your glasses rattle
Like a flint-lock gun.

S. P. R. R. Transit.

Diamond Drills and the Ventilation of Long Tunnels.*

M. Salomon suggested that the Society appoint a commission to examine into the technical causes of the industrial and commercial crisis now existing in France. He referred to what had already been done in the question of railroads. The Commission to be appointed, should be charged with framing a series of questions, to be sent to all the great industrial centres. In support of his motion, M. Salomon explained his reasons for such investigation.

M. Mallet, made some remarks upon the paper of M. Colladon upon "Rotation Drills with points of steel and of black diamond." He said that it was to M. Leschot, Engineer of Arts and Manufactures, that engineers were indebted for the first idea of using black diamonds in drilling. At the time of making the initial experiments, the black diamond only cost 4 to 5 francs ($0.80 to $1.00) per carat M. Leschot proposed to set eight or ten fragments in the end of a perforated cylinder, and turn this cylinder rapidly by proper machinery; a pressure of 440 to 660 lbs. upon

* From the Proceedings of the Society of Civil Engineers of France, of March 7th and 21st, 1884, held in Paris.

the rock was required to abrade it; a current of water, under pressure, delivered through the hollow drill, carried away the debris. M. Brandt had obtained the same result by points of tempered steel; but in this case a hydraulic pressure much greater in amount was required upon the tool. This pressure was 4,400 lbs. The rock was thus removed in very small fragments and the drill wore away very slowly; if the pressure was insufficient, on the contrary, the drill would wear out rapidly. By this last system, it was possible to advance 6.56 ft. per hour in limestone, and 3.28 ft. in granite. Unfortunately, in 1878-80 the black diamond had advanced in price to $5.60 per carat; for this reason it was not used in the St. Gothard tunnel.

M. Brull read a communication from M. Crampton upon the "Advantages in long tunnels of three separate openings; from a constructive point of view, for ventilation and for working." M. Brull referred to the system proposed, some time ago, by M. Crampton, for removing the debris from the tunnel protected, under the Channel. Since that time he had studied the question of sub-marine tunneling, and now brought to the notice of the Society a system of ventilation for long tunnels; a system patented by M. Crampton. Tunnel work is becoming each day more important, and for the same reason more difficult to execute. After the St. Gothard will come the Simplon, and then the one under the English Channel; that is to say, that now we do not shrink from undertaking the construction of tunnels from 18 to 30 miles long. M. Crampton estimated that in tunnels like these, it would be absolutely necessary that the passage through be made as comfortable as possible, that a pure atmosphere be provided for the passengers, and that the expenses of construction be reduced to a minimum. Two tunnels of smaller dimensions and joined together, have already been used instead of one large tunnel. M. Crampton proposed to establish three tunnels, parallel to each other, of small section, and thus obtain the maximum of advantage with the minimum of disadvantage. These tunnels would be built of a section large enough to permit the maintenance of the way during the circulation of trains. They would be 18.86 ft. in diameter, or say 370 sq. ft. in section. About half way in their length they would be united by large passages permitting free communication between the exterior air and the three galleries; towards the middle of the two halves would be a transverse chamber, either above or below the three galleries, and doors or valves by which communication could be either established or not, between the chambers and the galleries.

By closing two out of the three doors, two galleries would be isolated from the third. Then by means of a shaft connecting the transverse chamber with powerful steam machinery, the vitiated air could be withdrawn. With two galleries communicating, and both shut off from the third, the foul air would be extracted from the two, and the fresh air pass in by the third. By the proper use of valves, each of the three galleries can be used for the admission of pure air.

M. Crampton proposes to place the rails upon girders, which would themselves rest upon a floor of brick or beton, with some elastic material interposed; a brick drain between the rails would carry off the water. By this arrangement their would be an enormous saving in manual labor in caring for the road-bed and fewer workmen would be required. Further three tunnels would be easier to build and present less danger in execution; 21 per cent. would be saved in the masonry, and 6 per cent. in the excavation. And to ventilate the three tunnels, a motive force of 170 H. P. would suffice, while at least 500 H. P. would be required for the ventilation of a single tunnel.

The meeting of the Society of March 21st, was entirely taken up in the reading of a paper by M. Couriot, upon, "An Examination into the different laws proposed, relative to the workmen in Mines."

PERSONAL.

THE office of the RAND DRILL CO. was removed from 240 Broadway, to 23 Park Place, on the first of May.

THE New York Mastic Works, E. H. Wootton, Manager, has removed from 35 Broadway to 29 Waverly Place, between Broadway and Washington Square. See new advertisement on front page.

CHICAGO, Ill., April 25.—Joseph F. Tucker, general manager of the Illinois Central Railroad, has resigned. Mr. Tucker has been in the service of the Illinois Central for twenty-eight years, and is one of the most widely known railway officials in the West.

J. D. HAWKS, formerly Assistant Division Engineer on the Lake Shore road, and more recently Superintendent of Maintenance of Way on the West Shore, has been appointed Chief Engineer of the Michigan Central Railroad, an office made vacant by the recent death of Chief Engineer Phelps.

MR. GEORGE B. LAKE, First Assistant Engineer of the A., T. and Santa Fe road, died on the 27th ult., at his residence in Topeka, Kan., of pneumonia. So entirely unexpected was the announcement of Mr. Lake's death that his numerous friends were shocked, the whole community surprised, and everybody grieved. Mr. Lake had been connected with the Santa Fe road in the Civil Engineers' department, under Mr. A. A. Robinson, about twelve years, and was looked upon as one of the best men the company had. Since Mr. Robinson became general manager of the road, Mr. Lake has been at the head of the department. The remains were sent to Howell, Mich., in a special car furnished by the company. They were accompanied by Mrs. Lake and some of her most intimate friends.

MR. W. B. KNIGHT, of the now well-known firm of Civil Engineers, Knight & Bontecou has been reappointed City Engineer of Kansas City, Mo. We take pleasure in giving the following extracts from leading Kansas City journals:

"The reappointment and confirmation of Mr. Knight is an earnest to the taxpayers that the splendid system of public improvements, so hapily inaugurated under his past administration as City Engineer, will go right along for the next year. No rings will control the contracts, and the property owners can rest assured they will get the worth of their money. The foolish and vicious warfare raged against Mr. Knight by the *Journal* clique seems to have done him but little damage thus far."—Kansas City *Times*, April 22nd.

"In the matter of appointments, Mayor Talbott last evening displayed an amount of nerve and independence that has given his friends good reason to be proud of their support of him. The question of City Engineer was, of course, the pivotal one, and in appointing Mr. W. B. Knight, he carried out the wishes and recognized the judgment of every fair-minded resident who has no axe to grind. The warfare on Mr. Knight was made by the same element that is popularly supposed to wield a weighty influence in the council and whose sole animus was that they could not use him. Recognizing that his competency and honesty were the basis of the only objections that any one had to him, Mayor Talbott insisted upon his retention in office and carried the point in the face of more or less objection."—Kansas City *Star*, April 22nd.

The Pike's Peak Railroad.

The Pike's Peak Railroad, the completion of which within the next eighteen months is practically assured, will be, in many respects, the most notable piece of track in the world. It will mount 2,000 feet further heavenward than the famous Lima and Oroya Railroad, in Peru, which is now in operation to a point 12,220 feet above the sea, the highest that the rails have as yet attained. The obstacles that are being met and overcome in its construction are among the most formidable yet presented to engineering skill. The entire thirty miles of its length will be a succession of complicated curves and grades, with no piece of straight track longer than 300 feet. The maximum grade will be 316 feet to the mile, and the average grade about 270 feet. The line will abound in curves from 500 to 1,000 feet long, in which the radius changes at every chain. Forty-degree curves are numerous, and there will be one of forty-two degrees that will describe three-quarters of a complete circle. The road is being built in the most substantial manner, and will be laid with forty-pound steel. The engines will be built by H. K. Porter, of Pittsburg, and will be of the same pattern as those now being successfully employed on the Lima and Oroya Railroad, where they are mounting grades of 448 feet and attaining practicable speed of eighteen miles an hour. The coaches will, in all probability, be built by the Pullman Company, and, while especially strong, will not be more than one-third the usual weight. They will be, in fact, observation cars, the upper part of the bodies being composed almost entirely of glass. The running time will be about fifteen miles an hour. It is expected that the road will cost from $12,000 to $15,000 per mile.

The first section of eight miles, climbing from Manitou to the beautiful little dell called Crystal Park, 2,000 feet higher in the air, is now under active construction, the company having eighty men upon its pay-roll. It is fully expected that the line will be in operation to this point by July 1st, and to timber line, about eighteen miles further summitward, by the close of the present year. Fully two-thirds of the grading of the first section is completed, and the line climbing the foot-hill slopes is plainly seen from Colorado Springs. Though the work is necessarily more expensive at this season of the year, no stress of weather will be allowed to interfere with its steady prosecution.

Engineers' Club of Philadelphia.

(*Record of Special Business Meeting, April 19, 1884.*)

President William Ludlow in the chair; 36 Members and 5 Visitors present.

The following gentlemen were elected Active Members of the Club; Messrs. W. Hunter, H. K. Nichols, Stewart L. Neff, Lloyd Bankson, Wm. B. Reilly, Jas. R. Schick, Jesse Garrett, Theo. H. Lüders, J. Chester Wilson, W. S. Sheafer, S. B. Whiting, Frederick V. Mattan, Jno. W. Nute, Paul C. Brewer, H. W. Loss, Jones Wister, Geo. W. Bramwell, John S. Naylor and Sam'l R. Marshall.

Mr. S. N. Stewart, Visitor, described a Cushioned Pier and Rolling Trunnion Draw-Bridge. With a working model he showed that a 6 lb. draw could be turned by a penny-weight pressure or a breath, and claimed that, with a leverage six times as great as that of the model, 20 lbs. pressure would turn a 100 ton draw. He also claims that a pivot-bridge, swinging in a horizontal plane, is a trap into which men, teams and railroad trains fall every year, while a Bascule draw, rising in the air, closes the approach and serves as a signal warning. Referring to his project for a bridge across the Delaware, he said: "Hitherto the restrictions imposed by the authorities have been practically prohibitive, but the land interests are as much to be considered as those of navigation, for rivers were not made for mariners alone; and the land interests are really greater than the interests of those who go down to the sea in ships. A compromise should be effected, for a bridge has already become a pressing need and will soon be a positive demand." Mr. Stewart claimed that a bridge only 20 feet wide would accommodate two continuous streams of vehicles and still leave a wide foot-way.

Mr. Wm. P. Osler presented, for Mr. J. Godolphin Osborne, an account of the Pocahontas Mine Disaster, and the subsequent steps taken for the recovery of the bodies and the resumption of mining. He submitted the March number of the "*Virginias*," as containing an accurate detailed description of the mine and plan of the workings, from data by Mr. W. A. Lathrop, Supt. He then showed how probable it was that gas would have been detected by the engineers, had it existed; explained Mr. Lathrop's theory, afterwards verified, of the location of the fire; the method of damming and flooding the mine with 17,500,000 gallons of water to extinguish it—the

latter being accomplished in 16 days, 1 day being lost in repair of a dam; and the recovery and identification of the bodies. He states that the mine itself is but litttle damaged, that the cause of the explosion is, as yet, unknown, and, in conclusion, refers to the ridiculous and imaginary statements that have been published.

Mr. E. S. Hutchinson supplemented the above by an account of his recent visit to the mine, confirming, as far as he had observed, Mr. Osborne's opinion of damage to the mine; timbers were displaced, cars demolished, etc., but there was no fall of roof except in the fan entry, where much slate had fallen, but where a week's work would repair damage. He attributes the safety of the roof to the fact that 12" to 18" of coal had been left as an elastic support to the treacherous slate above. He considers the presence of 5 or 6 inches of fine, dry coaldust on the floor, a phenomenon of special interest, and, while withholding a positive opinion in view of pending investigations by a committee of the Am. Inst. Min. Engrs., he refers to a number of authorities to show the important bearing dust explosions have upon safety in mines, like this, apparently entirely free from fire damp.

Mr. J. Foster Crowell announced that the new bridge of the Pennsylvania Schuylkill Valley R. R. over the Schuylkill River at Manayunk had just been completed, and noted, as a remarkable illustration of the vast strides made in American Bridge Construction during the past few years, that so large and important structure as this is, being one-third of a mile in length and 90 feet high, can be reared and come into use without exciting special interest or even deserving particular mention from an engineering point of view. There were, however, ce tain structural features, arising out of some peculiarities of location, which might prove instructive, and these were briefly described and illustrated by blackboard sketches.

The Secretary read, from Mr. J. H. Murphy, a discussion of the Switch Formulæ by Mr. John Marston, recently published, which was extended to a discussion of curve location by Messrs. J. F. Crowell, A. R. Roberts and the Secretary.

Mr. A. R. Roberts described a contrivance he had designed, by which a three-throw point switch can be operated from a single stand.

The Secretary read, for Prof. L. M. Haupt, a letter from Prof. Louis H. Barnard, urging an interest on the part of the Club in the election of Trustees of the State College, and it was referred to the Secretary with instructions to confer with Prof. Haupt and report at next meeting.

The Secretary explained that the Reference Book sheets were all published in the Proceedings, and, in that form, were open to purchase by any non-member desiring them, but he considered that their *separate publication in note book form* should be exclusively for the benefit of Club Members, and offered a motion to that effect, which was carried.

Liverpool Engineering Society.

The seventh meeting of the Session was held on Wednesday evening the 9th of April at the Royal Institution, Colquitt Street. The President Mr. R. R. Bevis Jr., in the chair, when a paper entitled "Improvements in Locomotive Engines" was read by Mr. John B. Fell.

The author commenced his paper by pointing out that the Locomotive Engine has already been brought to such a state of perfection that there might appear to be no need of further improvements. And these if made must rather relate to new developments of its powers, or new applications of them, than to the ordinary work in which it is at present employed. Therefore the improvements that will be dealt with in this paper are those relating to:

First. High speed Locomotives.

Second. Increased economy in worki g expenses.

Third. Engines for working upon steep inclines or mountain railways.

The present average maximum speed of the Locomotive Engine is from 40 to 45 miles an hour upon which no advance has been made for many years, but during the last twelve months there has been a discussion in the Engineering and Scientific papers as to the practibilty of increasing that speed on railways of 4 feet 8½ inches gauge, to an average maximum speed of 60 miles an hour and to a speed of 80 miles an hour on railways with a 6 foot or 7 foot gauge. The conclusion aimed at was that this could not be done with any existing type of locomotive, but that it might possibly be accomplished if certain conditions cou d be complied with: the most difficult of which is the providing of the necessary additional amount of boiler power, which could not be done with a boiler placed as at present over the engine and limited in width to the space between the driving wheels.

The only possible arrangement by which this object can be effected appears to be that of separating the boiler from the engine giving it he place now occupied by the tender, and removing the water and coke to the carriage carrying the engine, by which means ample space could be provided for both engine and boiler, and there would be no difficulty in producing double the quantity of steam in the same time that is produced by the most powerful express engines now in existence, and consequently running at double the present speed, upon a railway of a suitable guage.

The second part of the paper relates o the application of the new arrangement of the parts of a locomotive to engines for working heavy goods and mineral traffic. In this case a much larger amount of adhesion has to be provided, the additional mechanical power being employed, not for obtaining an increase of speed, but an increased force of traction at a low speed, by which means heavier trains may be drawn without increasing the load on any one of the engine axles, and a reduction effected in the working expenses by the use of a more economical form of boiler.

The third part of the paper consists in a description of recent improvement in centre rail engines, which have been designed for working on the proposed trans-alpine railway over the pass of the Mont Genevra.

CORRESPONDENCE.

Obstruction of Cross Gutters to Surface Drainage.

Special Correspondence Engineering News.

MADISON, WIS. April 28, 1884.

EDITOR ENGINEERING NEWS.—In Mr. Moore's discussion of Kansas City Sewerage problem, he speaks of the serious obstruction to traffic caused by the cross gutters necessary to carry the surface water over intersecting streets, as though such open surface gutters at intersections were necessary evils wherever storm water sewers have not yet been built.

In very many of the smaller towns in this region as yet unprovided with sewerage, this difficulty is entirely and very satisfactorily overcome by building vitrified pipe culverts at street crossings. These require but a thin covering to protect them from being broken by passing loaded wagons, are always clean, cost but little, if any, more than the surface gutters at first, and so far as our local experience goes (as yet limited to half a dozen years) seem likely to be less costly to keep in repair.

It was anticipated that in our severe climate some difficulty would be experienced in keeping them from getting clogged with snow and ice. So far, however, they have given much less trouble than the surface gutters which they replaced.

The pipe used here has invariably been only of the standard thickness for ordinary sewer pipe. Where there is heavy traffic it is easy to substitute much thicker pipe and prevent all danger from breakage.

Wherever there are grades of four per cent. and upward, there is little difficulty in using circular pipes of capacity equal to that of gutters of safe depth. For flatter grades, special designs can easily be made of less depth and sufficient capacity up to the proper limit for such drainage.

Wherever this construction is possible (and places where it is not, it seems to me must be rare), the objection urged by Mr. Moore to surface dispcsal of storm water that "the cross gutters necessary to carry the water over intersecting streets are serious objections to public traffic," can not fairly be urged.

ALLEN D. CONOVER.

THE OHIO FLOODS.

170 BROADWAY, N. Y. April 23, 1884.

EDITOR ENGINEERING NEWS.—In the short expression of opinion on the alleviation of these floods, as to their most dangerous conditions, which you did me the favor to publish, April 5th, I stated, among others, these propositions:

That storage reservoirs are the usual rule of the profession, and give effective results.

That water courses usually offer convenient locations for their construction.

That the basin of the Alleghany, with which I was familiar to some extent, held various favorab e sites for this purpose, and that other basins, as the Mcnogahela and Kanawha, surveyed by competent engineers, gave similar results.

That similar construction in other cases, indicated, by analogy, the pondage of a very important supply and control at a moderate cost.

That until those who oppose this remedy, show another which is better, or disprove its possible app'ication here, the most ample encouragement should be given to careful survey and location of such structures, primarily to control the top wave of the occasionally combined floods above Cincinnati, with a view to greater control, and improved navigation, mill power, and collateral benefits.

As a local illustration, I cited the survey of the Meadow Creek reservoir on a tributary of the Kanawha where it was reported that an expenditure of $583,200 would pond 10,722,000 cu. ft., to which another branch would add 3,377, being more than one-fourth the amount required (44,196,000), to reduce the dangerous crest of an excessive flood, as demonstrated by Charles Ellet, Jr., C. E., in his elaborate study of 1843 to 1849, at Wheeling. Reference was also made to the Upper Mississippi and Hudson River reservoir surveys.

As the work of the Army Engineer Corps, I also refer to the Report of Capt. Chas. J. Allen (Chief of Engineers, 1880), which shows, with elaborate examinations, which evince, at every page, the care and skill with which he and his assistants decided the problems, that reservoirs on the Upper Mississippi, the St. Croix, the Chippewa and the Wisconsin rivers will pond, respectively, 55,796, 34,334, 26,458 and 19 557 millions cu. ft., or 135,745 in all, at an aggregate cost of about $1,390,790; and with some intermediate stream improvements, will give the Mississippi, below the mouth of the Wisconsin, in 90 days, dry run 36,000 cu. ft. per second, or more than three times the uncontrolled run; and the estimated quantities are low, taking only 0.7 ft. available, of 2.08 ft. rain.

Surely, then, with such facts as these coming in, locally, to support a world-wide law of control, it is not professional to say to the army of sufferers along the Ohio, "Science knows no remedy for you, and your future punishment will be worse than the present."

In your issue of the 12th, Lieut. Col. Merrill has done me the honor to make a prompt, if not a hasty comment on what was said, and proposes that I shall first educate myself in a certain Report, and then take the fire off his battery, if the Report does not silence me.

My allusion to "a distinguished engineer, who could not find precisely six sites for as many reservoirs on inspection," ought to have been a sufficient intimation of my entire familiarity with the Ellet, Morris, Roberts, Haupt controversy on the Ohio improvement. The Quixotic search of Mr. Roberts along the affluents to find these sites, each to drain 600 square miles, and pond 25,000,000 cu. ft., so as to control 150,000,000 where Mr. Ellet was content with 46,196,000 and the ingenuous way in which he does show how easily this can be had, is a curiosity in the literature of hydraulic controversy, and does an engineer of high standing no credit. The Colonel will therefore permit me to claim Mr. Roberts, *malgre lui*, as on our side of this question, for he names *seriatim*, valley after valley, well adapted to pondage, though not to his Procrustes' bed.

In his haste, the Colonel has also said, or left it to be inferred, that the Meadow Creek reservoir, as located by Mr. Ellet, and re-surveyed for the Report of 1873, was only an "office plan"; an explanation as to the invention of its elaborate details is in order.

As to a controversy on this question, I propose to decline it for two main reasons aside from the urgent preoccupation of daily work, which has prevented an earlier acknowledgement of the challenge.

First, until the plain propositions I have stated are disproved, as experienced engineers would prove or disprove them, the field is entirely at his command, and the contest is with the profession, *per se*, in its traditions as well as practice.

Second, I have no taste for controversy, for the sake of dispute, and I avoid it. When important principles are at issue, or where the keen sword play of expert testimony is required, when circumstances control, I

am ready to act, and not otherwise. With or without Gen. Haupt's experience in view, then, I certainly shall content myself by stating the propositions I have submitted. They will stand, without my aid long after my work is done.

SAMUEL McELROY,
Civil Engineer.

Boiler Explosions in England.

In the last Annual Report of the Manchester, Eng., Steam Users' Association for the prevention of Steam Boiler Explosions, and for the attainment of economy in the application of steam, Lavington E. Fletcher, C. E., Chief Engineer; the committee reports as follows: Boiler examinations, in 1883, were 13,590 in addition to 139 Economizer examinations, and 1,237 indications of Engines. Of the boiler examinations, 4,832 were "Entire." During the year 42 explosions came to the knowledge of the committee, resulting in the loss of 31 lives and in injury to 49 other persons. One of the boilers included in this number was under the inspection of the Association, and guaranteed by it, but no life was lost and no personal injury occasioned, whilst the occurrence itself did not in any way reflect upon the Association's service, the cause of the explosion being shortness of water, owing to the attendants having thrown the blow-out tap in the wrong direction, leaving it, as he supposed, closed, whereas it was open at full force.

The conclusions expressed by the Association are in accord with those of a late report to the Board of Trade upon the workings for one year of the "Boiler Explosions Act, 1882," as follows: That boiler explosions are not accidental, but may be prevented, that the prevailing cause of explosions is the unsafe condition of the boilers through age, corrosion, wasting, &c., and that the principle of steam boiler insurance doe not insure safety.

The distinctive feature of this Association, an annual "Entire" examination of every boiler enrolled, would, if universally applied, almost, if not entirely, obliterate the term explosion as applied to steam boilers.

Considerable attention has been given by the Committee during the past year to the subject of Incrustation. At the November meeting the Chief Engineer presented to the Committee a manuscript Report detailing what the Association had done in the past to assist its members, and what it was still doing. For the prevention of Incrustation it recommends very generally, on the authority of Dr. R. Angus Smith, confirmed by its own experience, the use of soda ash of good quality, advising that it should not be put into the boiler through the manhole in heavy charges in cleaning times, but that it should be pumped in along with the feed. It also recommends that blowing out of the boilers should be regularly maintained, and that they should not be emptied under steam pressure so as to be left hot and allow the scale to bake on and harden, but that they should be allowed to stand with water in them until cold, and then that the blow-out tap should be opened and water allowed to run out by its own weight. These are simple remedies, and, generally speaking, would do what is required. It has been decided to reprint and circulate amongst the members Dr. R. Angus Smith's report upon an analysis of several of the waters in Lancashire, made some years ago for the Association, and containing recommendations as to the best methods of treatment. To this will be added other information and experience obtained since that time. This publication, it is believed, will be found to be very useful, and will be appreciated by the members.

The "red-hot furnace crown experiments," to which reference has been made in previous reports, have been concluded during the past year, and the results will shortly be made known to the members in the printed reports.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 205*)

DCXXVII. MAYSVILLE, KY.

Maysville, Kentucky, in lat. 38° 40′ N., long. 83° 42′ W., the county seat of Mason County, is on the Ohio River, the surrounding country being very rough.

Settled in 1785, it was incorporated a city in 1825. Water-works were built in 1880 by a private company, after plans of Travers Daniel, taking the supply from the river, and pumping by two Blake pumps, one of 16 inch cylinders, and 36 inch stroke, and one of 19¾ inch cylinder and 36 inch stroke to two reservoir basins each holding 1,250,000 gallons at 425 feet above low water mark. The pressure in the pipes is 155 pounds.

Distribution is by 9 miles of cast iron pipe of 14 to 3 in. diameter, with 50 fire hydrants, 52 gates, 30 meters and 402 taps. Service pipe has been of galvanized iron, but hereafter lead will be used.

The City pays $50,000 for all future use of hydrants. The population in 1880 was 5220, it is now said to be 8000. The daily consumption in 1883 was 150,000 gallons. The works have cost $150,000. The receipts to date have been $19,500. The expenses in 1883 were $6,000, and the receipts $7,000.

The capital stock of the company is $50,000, and its bonded debt $50,000. Jacob Toreger is President, and August Schaeffer Superintendent.

DCXXVIII. CHEBOYGAN, MICH.

Cheboygan, Michigan in lat. 45° 45′ N., long. 84° 45′ W., is on Lake Huron or Straits of Mackinaw, and is built on generally level ground, which continues some distance back from the lake and then rises to an elevation of of 600 feet.

Settled in 1846 it was incorporated a village in 1871. Water-works were built in 1882 by the village after plans of Geo. P. Smith, the supply being taken from an artesian well 300 feet deep 180 feet being 7 inches and 120 feet 5 inches in diameter. The water is pumped directly into the mains by a pump of 14 inch steam, and 8 inch water cylinder and 12 inch stroke, made by M. Walker, Port Huron, Mich. The ordinary pressure is 40 and fire pressure about 90 lbs. The works have been tested 160 lbs. In case of necessity water from Lake Huron can be used. Distribution is by 3 miles of Wyckoff wooden pipe of 12 to 4 in. diameter with 22 fire hydrants, 46 gates, and 75 taps. The population in 1880 was 2,269, it is now stated as 4,000. The works have cost about $27,000, the bonded debt is $25,000 and the receipts to January 1, 1884, have been $450.68. The works are managed by a board of water commissioner, Geo. W. Bell is Chairman, and J. P. Sutton, Secretary.

WATER.

SPRINGFIELD, Ill., is putting down a 54 inch diameter well for an improved water supply. The Jerseyville, Ill., Water-works were tested on the 15th ult. W. R. COATS of Kalamazoo, Mich., is Engineer of both works.

WACO, Texas, April 26.—A proposition from the Waco Water Company for a new contract with the city, is under consideration by the commitee appointed at a recent meeting of the City Council, which, it is rumored, will be reported upon favorably at the next meeting. Under the contract proposed the city is to take eighty-three hydrants, at $100 each, the contract to run twenty years from its acceptance. The Water company obligates itself to build a reservoir of sufficient capacity to supply the demands of the city, and to place hydrants on mains not less than four inches in diameter. Considerable interest is already manifested by the public in the matter, and lively times may be expected when it is presented to the council for action.

HOPKINTON, Mass., April 29.—One hundred men employed in putting in the water works, struck this morning, refusing to work under the new boss just appointed. They will be paid off and new hands put in their places.

RICHMOND, Md., on the 26th ult., voted in the primaries dead against the construction of water works under the charter granted the Construction company. Probably after some amendments are made, the charter will be ratified.

WE have received a neatly prepared schedule of Water Rates as amended and revised by the Water Commissioners of Taunton, Mass. We are very much obliged, and we will be pleased to be remembered likewise by the superintendents of other water-works.

THE Knowles steam pump Works, Boston, are busy on their general line of work; have taken a large number of orders lately for their improved air pumps and condensers, also for a number of water works' plants.

THE prospect of a dam at Brattleboro' Vt., which will convert the town into a manufacturing centre, is said to be good. An engineer reports the thing entirely feasible and that the dam can be finished for $110,000. It is estimated that the land damages and canal would cost $65,000 more.

THE George F. Blake Manufacturing Company, Boston, have in process of erection a large duplex pumping engine for a western city; have just shipped a duplex power water pump to a large iron works in the south, and also to another southern city a duplex compound pumping engine of one millon gallons capacity.

THE Crystal Water Company, which has been organized to supply the east shore of Staten Island with water, had a commission appointed to appraise the value of land needed by the company for a reservoir, and the commission has awarded the damages at $17,500 in the aggregate.

AN agent of the Holly Manufacturing Co. has made surveys, and estimates the cost of water-works in Sauk Centre, Minn., at $11,650 or $13,650. A special election was held April 30th to vote on the question of issuing bonds to the amount of $14,000 to be used for constructing water-works.

THE Committee on Water Supply, Mass. Legislature, heard Mr. William H. Ingraham, Town Clerk of Watertown, in support of the petition of Alfred Hosmer and others for incorporation as a company to supply the people of Watertown with water taken from sources within its limits, the capital of the company to be $200,000. A bill for the necessary legislation will be reported.

CITY Engineer Rosewater, of Omaha, Neb., says that the water supply which now reaches 2½ million gallons per day, is muddy, and more setting basins are needed. The present basins have a working capacity of 5 million gallons, or they hold two days supply at the present rate of consumption. He says this storage capacity should be raised to 10 or 15 million gallons, so as to permit sufficient time to elapse for the deposit of the sediment from the muddy Missouri.

THE Elkhart, Ind., Water Company, capital $10,000; Albert M. Gilbert, president, has been incorporated. Franchise to run 25 years on a basis of an annual rental of $75 per hydrant. Seven miles of mains and 80 hydrants to begin with. Fairbanks, Morse & Co., of Chicago, represent the water company. The engineer is W. R. COATS, Hydraulic Engineer, who also built the Kalamazoo, Mich., Water works, and who is a strong advocate of taking a supply from deep wells.

THE Southwark Foundry and Machine Company, of Philadelphia, have just received an order from the Cambria Iron Company, Johnstown, Pa., for two Porter-Allen engines of 400 and 500 horse power. These engines, when running, will make a total of thirteen Porter-Allen engines in use by that establishment. The Southwark Company are also building for the Atlantic Refining Company a compound duplex pumping engine of 5,000,000 gallons capacity.

MESSRS. HINDS MOFFETT & Co., Engineers and Contractors of Watertown, N. Y., have the contract for building Water-works at Pen-Yan, N. Y., the water to be taken from Keuka lake and pumped by steam through about five miles of cast-iron pipe from ten to four inches in diameter; there is also to be a wrought-iron water tower 25 feet in diameter and sixty feet high located on a hill within the village and connected with the street mains. The work to be completed Jan. 1st 1885.

CORSICANA, Tex., is thoroughly aroused to the importance of perfect protection, and the plans now being prosecuted will be as near perfection as it is possible to attain. Two large reservoir cisterns are being sunk in Beaton street, to be completed in thirty days One fire engine is already received, and is safely located in the new engine house. The money has been raised to purchase another engine, which will soon be received. Two excellent fire companies have been organized, one of which is already thoroughly equipped for fire-fighting. The water-works are being prosecuted as rapidly as men and money can overcome the obstacles, and it is confidently expected that the four miles of now empty water mains sunk in the streets will soon be full of water, affording absolute protection to every part of the City.

A REPORT from Major G. L. Gillespie was laid before the Senate on the survey of the Passaic River. The report says that the many valuable manufacturing interests on this river, from the source to the mouth, and especially above Newark, justify him in regarding the river from Passaic to Paterson as worthy of improvement and a work of public necessity. He recommends that a careful survey of the river be made from the mouth of the Weasel Creek to Paterson, and estimates that an appropriation of $1,500 will be required for the purpose.

ECONOMY IN PUMPING MACHINERY.

TERRE HAUTE, IND., April 28, 1884.

EDITOR ENGINEERING NEWS.—With much pleasure I observe that in your editoral of the 26th inst. you take the same views in regard to annual reports (for the benefit of the Association) that I endeavored to express in an article read before the Convention at Cincinnati, and in conformance with which, a committee was appointed to report a form, etc.

In order to arrive at a comparison of economy in pumping machinery, in different localities, the relative value of fuel in use should be known, and put in tabular form. This can only be done by obtaining a large number of tests from all parts of the country, where a very close approximation could be made, by districts, (a reliable table of this kind would also be valuable for builders of pumping and other steam machinery). If you would kindly, through the columns of your paper, request *any* persons having a record of such experiments, either positive or comparative, to forward them to me, you would confer a favor and save the committee much work.

Respectfully yours,
J. G. BRIGGS,
For the Committee.

WATER RATES IN BALTIMORE.—The water ordinance offered by Mr. Weyler in the Second Branch of the City Council last week, differs somewhat from the ordinance under which the present water rents are imposed, and equalizes the water rates to a greater extent than the ordinance now in vogue. The rates at present are: Private houses of 12 feet front, $3; over 12 feet and not over 14 feet, $5; over 14 feet and not over 17 feet, $9; over 17 feet and not over 22 feet, $12; over 22 feet front, $14. By Mr. Weyler's ordinance, if passed, the rates will be: Dwellings of 12 feet front, $4; 13 feet, $5; 14 feet, $6; 15 feet, $7; 16 feet, $8; 17 feet, $9; 18 feet front, $10, and so on, and all over 22 feet front, $16. Thus, it will be seen, if Mr. Weyler's ordinance goes into effect, a person owning a house of twelve feet front would pay $1 more than now, while a proprietor of a thirteenth-foot house would pay $1 less than at present, and for a fourteen-foot house there would be no change in the rates. On a house fifteen feet front, $2 would be saved; on a house sixteen feet front, $1, and for a seventeen-foot house the rates remain the same. The rates on an eighteen-foot house would be $2 less, nineteen-foot house $1 less, with the rates on a house twenty feet front unchanged, and a house twenty-one feet front would pay $1 more than at present, and a twenty-two-foot house $2 more, and one over twenty-two feet would pay $2 more than under the present rates. The charges for water used in warehouses remains the same as at present. Mr. Bankard's bill abolishing water rents, which passed the First Branch last week, has not yet been brought up in the Second Branch, where it is probable that Mr. Weyler's ordinance will be offered as a substitute. The revenue of the water department would be slightly increased by the rates provided for in Mr. Weyler's ordinance over the prevailing rates. The ordinance, just as the one now in operation, would require three cents to be levied for use of the water consumed by the fire department and other departments of the municipal government.—Baltimore *American*.

AN ASTONISHED INSPECTOR.—The insurance companies, remarks the Milford *Gazette*, must have plenty of money. Every few weeks somebody comes in and looks our premises over, glances at the stovepipes, smells the benzine bottle (sometimes with a disappointed face), and asks all sorts of questions. We do not grumble. We like to see people active, and are glad to discover that some people are impertinent besides newspaper reporters.

One of them called at the *Gazette* office the other day. He looked up stairs and down, and found no fault till, peeking through a window from the composing room into the cellar, he discovered a small boiler surmounted by a steam gauge which registered a pressure of 115 pounds. He was evidently astonished, and inquired if we considered the boiler safe to use.

"Perfectly."

"You are running an unusual pressure. What is your safety-valve set on?"

"Don't know. Never examined."

"Has the boiler been tested recently?"

"Not that we know of."

"Do you always run that amount of pressure?"

"Usually."

"You are running a great risk. Shall have to examine it at once. You are endangering the life of every person in the building. I must order you to reduce the pressure at once, and I will see that the boiler is inspected."

We made no reply, but when that man examined the boiler and found that it was merely a shell which had not been fired up for half a dozen years, and that the "printers' devil" had fixed up the steam guage in his spare moments, while waiting for copy, he said naughty words, which so shocked us that we have turned the guage around, and the only person who can look at it is the boy who comes in to guess at the gas meter.

The *Gazette* runs its presses by a water motor.

NEWS OF THE WEEK.

Gas and Electricity.

THE Cambria Iron Company and the Gautier Steel Department, at Johnstown, now have 89 electric lights and 34 telephone. A new electric engine who recently set up at the rolling mill. Mr. I. W. Watterman, the electircian, and five assistants are kept busy.

THE Lighthall Cable Tramway Company filed a certificate of incorporation recently. The object is to operate the Lighthall patents and endless cable system throughout the United States. The capital stock is $500,000, in $10 shares. The board of trustees is composed of the following officers: A. H. Lighthall, President; John L. Mills, Vice-president, and F. W. Jones, Secretary.

AT a meeting of the Directors of the Citizens' Gas Light Company of Quincy, Mass., recently, it was voted to increase the capital stock $15,000 and extend the pipes to Wollaston. Since the reorganization of the company about two years ago, the works have been remodeled and greatly improved, and the price of gas has been reduced. Notwithstanding the large outlay, the company is paying 6 per cent. dividends and is in a very prosperous condition.

GAS BUOYS TO ILLUMINATE A RIVER. QUEBEC, April 29.—Preparations for lighting up the river buoys with gas is in active progress, and it is expected that most of them will be so lighted by the middle of the summer. The works for the manufacture of the gas will be erected on the Queen's wharf, and each buoy will carry a sufficient quantity to last three months.

A NEW gas well was discovered on the 30th ult., near Washington, Pa., by the People's Heat and Light Company, A. B. Caldwell, President. The gas was reached at a depth of 2,068 feet. Mr. Gibson, the contractor, with his three men, has been at work boring this distance since the 19th of March. The People's Heat and Light Company is composed of 15 of the most substantial business men of Washington. They will begin piping the gas to that place as soon as the necessary pipes can be procured.

WHEELING, W. Va., April 22.—The greatest well of natural gas known to the world was struck at Wellsboro, twelve miles North of here, this morning. At a depth of 1,287 feet the reservoir was tapped and the fluid rushed out with such force as to throw the heavy tools high in the air and demolish the derrick. Up to this time all efforts to cap the tube and control the gas have been futile. A light has been applied and the glare on the sky is visible thirty miles away.

In quantity this well is estimated to be a half greater than the famous McGreiger well. Nearly $1,000,000 have been spent in this vicinity in boring for gas, but Wellsboro alone has been successful, having now three wells in operation, lighting and heating the town, melting iron and glass, and entirely superseding all other fuel. The last well will be piped to Wheeling, and supply the numerous mills, furnaces and glass houses here.

ON the 1st of January, 1882, a large railroad station in California was lighted by a local branch of the Brush Electric Light Company. The dynamo was made to furnish forty lights, and worked by a 40-horse power engine. Everything was made of the best material and put up by experienced workmen. Allowing six months to pass, so as to permit the expenses to be cut down to a minimum, and the employés to be trained to the best efficiency, calculations were made for the months of June, July, August and September, 1882, with the following result:

Average cost per month	$525 52
Average cost per night	17 06
Average number of lights nightly	30.09
Average hours of lighting nightly	.5
Average cost of one light nightly	.55
Average cost per light per hour	.11

Mr. Samuel Purnell, who makes this report, comes to the following conclusion: He states that the local opinion was that while the station was brilliantly illuminated by electricity, and better than gas could possibly do it, yet that sufficient light could have been obtained from gas for half the money.

Railroads and Canals.

A PRELIMINARY survey is being made of the proposed Manchester and Fitchburg Railroad.

THE Macksburg, Middlebury & Stafford Narrow Guage Railroad, capital stock $200,000, has been incorporated at Columbus, Ohio.

THE Kaskaskia, St. Elmo & Southern; Mt. Vernon, Tamaroa; Vandalia and Springfield Railroads, all in Illinois, are in *statu quo* as to construction awaiting the result of negotiations for money which make slow progress.

AT a meeting of the stockholders of the Burlington, Cedar Rapids and Northern road, held at Cedar Rapids, Iowa, on April 10th, the capital stock of the road was increased from $10,000,000 to $30,000,000. The contracts for northwestern extensions will be let at once.

THE Richmond, Va., and Danville Extension Company directors have authorized the construction of the Columbus Gap line on the Georgia Pacific Railroad. The new line will extend to Birmingham, Ala., and will be laid with steel rails. The new work will cost $900,000.

JAMESTOWN, N. Y., April 28.—Work was begun with a large force of men on the street railway to-day. Five miles will be built in this village. Cars and rails have already been purchased of Philadelphia parties. It is proposed to extend the road three miles, to the junction of the New York, Pennsylvania and Ohio, Buffalo and South western, and Dunkirk and Pittsburg Railways. The stock, $100,000, is all held by local capitalists.

THE survey of the Central Nebraska Railway was began last week. The survey was commenced at Oakland, Neb., and the party will work east toward Decatur, twenty miles above the Blair bridge, where the bridge of the new road will cross the Missouri. It was reported that the surveyors belong to the civil engineering corps of the Northwestern railway company, but this is not certain.

ST. PAUL, MINN., April 24.—Articles of incorporation of the Iowa and Minnesota Northern Railroad Company were filled to-day with the Secretary of State to construct a railroad from a point on the southern boundary line of Minnesota to the northern part of the State, with extensions east and west of the main line within the State. Capital stock, $2,500,000. Work will commence May 2d. It is believed to be a part of the Rock Island system.

WATERLOO, Iowa, April 20.—Workmen arrived to-day to begin work on the extension of the Wisconsin, Iowa and Nebraska railroad. From its present terminus at Wilson about four miles from this city, the road will probably be at once built to Cedar Falls. The citizens of this place are at work getting subscriptions and right of way and raising funds to secure the building of the road into this city. The line will be extended to St. Joseph, Mo., this season.

A PRELIMINARY survey of the projected Lexington and Utica Railroad in Michigan, has just been completed by E. W. Muenscher, Chief Engineer, formerly City Engineer of Grand Rapids. B. R. Noble of Lexington, Mich., is President. The new road is about 60 miles long, and runs through very flat country, making the cost of construction very low. It is designed to be a feeder of the Detroit & Bay City Division of the Michigan Central Railroad and will open to that road a large section of territory, where traffic is now monoplized by the Grand Trunk Railroad and its tributaries. As the Michigan Central is deeply interested in the projected road it very likely to be built this season, especially as nearly enough local aid has been obtained to prepare the road for the track.

WHEELING W. Va., April 25.—Secretary of State, Stalnaker, to-day incorporated two R. R. companies. The first was the Charleston and Pittsburg, capital stock, $1,500,000. The company proposes to build a road from Charleston, Kanawha County, by the most practical route to Braxton Court-house. The principal office will be located at Charleston. The incorporators are Francis V. Green, of Washington, D. C.; Andrew Brockerhoff, Bellefonte, Penn.; Wayne MacVeigh, Philadelphia; Henry McCormick, of Harrisburgh, Penn., and Johnson N. Camden, of Parkersburg, W. Va. The second was the Chicago, Parkersburg and Norfolk, with a capital stock of $100,000. The principal office is to be at Parkersburg. The incorporators are A. C. White, Isaac Scott, A. N. Williams, W. L. Cole, George Loomis, G. B. Gibbons, Charles B. Smith, A. B. Beckwith, C. F. Scott, and S. F. Shaw, all of Parkerburg.

The men in both companies are responsible, and nearly all are prominent in the State. Both roads will undoubtedly be built.

CHIEF ENGINEER LUMSDEN, of the Ontario & Quebec Railway, began the work of surveying the route of extension of that road to Detroit. The rails and ties are ready to be laid as soon as the survey is complete. It is thought the line will reach there by August.

IN the Supreme Court of Massachusetts the Sinaloa and Durango Railway Company, of Mexico, has petitioned to be allowed to reduce its capital stock from $800,000 to $20,000, the enterprise so far being a financial failure.

THE Virginia and Western Railroad was organized at the Natural Bridge on the 17th. This road will run from a point on the Richmond and Alleghany Railroad (either at the mouth of Catawba or Craig's creek) through one of the richest mineral sections of the State. Along the proposed route, in the counties of Craig and Botetourt particularly, there is a vast wealth of maganese, working slate of a fine quality, iron-ore, and coal. The latter is said to be unsurpassed even by the coal of the Pocahontas mines.

The following are the officers of the new company: H. C. Parsons, President; S. McG. Fisher, Treasurer; D. H. Whitecomb, Chief Engineer. Directors: J. H. H. Figgat, A. McCartney, Elbert Fowler, Samuel Coit, William A. Anderson, J. C. McDonald, Samuel W. Williams. Counsel for the company, A. S. Baler, E. S. Fowler.

The amount of stock necessary to start the company was subscribed on the spot.

EASTON, PENN., April 24.—A corps of engineers are now surveying a line from the main road of the Bangor and Portland Railroad Company, near Pen Argyl, to connect with the Belvidere Delaware Division of the Pennsylvania Road at Martin's Creek. The new line is intended for drawing a large amount of the slate traffic from the Lehigh and Lackawanna, which a few days ago had an injunction issued to restrain the Bangor and Portland from crossing or tearing up its tracks at Pen Argyl. The Easton and Martin's Creek Railroad Company has decided to place the grading of the road under contract as soon as possible.

THE following statements, from the Wheeling W. Va., *Intelligencer* shows that the new Railroad Co., means business:

"A copy of the certificate of incorporation of the Mt. Vernon, Coshocton & Wheeling Railway was filed in the office of the Secretary of State. The capital stock was originally $100,000, but steps have been taken to increase the same to $5,000,000, and authority is asked to issue bonds according to the laws of Ohio. The plans and profile of a line into the city are being prepared, and as soon as an estimate can be made of the probable cost of the right of way an ordinance will be asked for granting the right, together with a proposition asking from the city and Ohio county a sum not exceeding $150,000, one-half to be paid when the track or road-bed shall be graded, the residue when the cars shall run into the city.

PARKERSBURG, W. Va., April 25.—A certificate of incorporation was issued to the Chicago, Parkerburg and Norfolk Railroad Company to-day, this being a connecting link of the Black Diamond system between Chicago and the Atlantic Ocean, and the most important line chartered since West Virginia became a State. The capital stock is privileged to $3,000,000, the incorporators being Charles Smith, Dr. Scott, A. Williams, A. Beckwith, W. Cole, Charles Loomis, A. White, Charles Scott, G. Gibbons and S. Shaw. President Albert, E. Boone was represented by Robert M. Hughes, assistant to the president of the Black Diamond system. New York and Philadelphia capitalists were represented.

COPIES of the annual statement respecting the Canadian Pacific Railway, made by Sir Charles Tupper, the British Minister of Railways, have been received in this city. The exact position of the Canadian Pacific is briefly stated as follows:

"Liabilities.—$7,500,000 received from the Government, bearing 5 per cent. interest, payable 1891; $1,381,000 5 per cent. land grant bonds unredeemed; $7,380,000 payable in 1888 to the Canadian Government; $55,000,000 of common stock sold and distributed, netting the company $25,296,828; $5,000,000 borrowed for one year on $10,000,000 additional stock as collateral. Total stock outstanding, $65,000,000.

"Assets.—Property on which the company has actually expended, as per report, March 3, 1884, $58,695,377; subsidy in the form of completed railway, as per official memorandum, 1883,(713 miles,) 21,247,000 acres of land; Dominion of Canada gaurantee of 3 per cent. interest per annum on stock outstanding for 10 years, from November, 1883.

To complete the Canadian Pacific Railway from ocean to ocean 780 miles remain to be built. To accomplish this the Canadian Government has bound itself to pay $27,710,000 as follows: In subsidy, $12,710,000, by loan at 5 per cent., $15,000,000.

In explanation of the telegraphed statement from Montreal that J. S. Kennedy and Duncan McIntyre were to retire from the Canadian Pacific directory, a gentleman prominently connected with the company said recently: "Mr. Kennedy retired about three months ago, soon after his retirement from active business in this city. He has not, however, disposed of any of his holdings. Mr. McIntyre may possibly retire from the position of Vice-President, but he will not go out of the Board of Directors."

THE master mechanic of the Indiana, Bloomington and Western system has recently been making a test of the coal consumption of their passenger and freight locomotives of the several divisions. He finds that the consolidation engines on the Peoria division average to haul 28 loaded cars 17 miles with one ton of coal, while the mogul engines average to haul 20 cars 19½ miles on one ton of coal. On the Middle division no moguls are used, but the consolidation engines haul 35 cars 20½ miles with one ton of coal, and on this division the passenger engines average to run 47 miles on each ton of coal consumed. On the Peoria division, which has steeper grades, 40½ miles with a ton of coal.

CANADIAN RAILWAYS.—An annual report of the chief engineer of government railways, upon the railways of Canada for 1882-83 has recently been issued. It announces an increase of 1,275 miles in the lengths of lines operated, making a total of 8,805½ miles, and states that when the uncompleted lines are finished the railway system of Canada will have an aggregate length of about 11,400 miles. The capital represented was $494,271,264.95, of which sum nearly one-fourth was contributed by the central and provincial governments and municipalities. The ordinary share capital was $195,591,837.68; preference share capital, $73,500,777.87; bonded debt, $102,134,295.45. The gross earning for the year were $33,244,585, and the net earnings, $8,552,918. which sum, it is stated, is "sufficient to pay, approximately, a dividend of 2½ per cent. on the share and bonded liability of the roads in operation." The earnings included $10,538,120 derived from passenger traffic; $21,320,208 from freight traffic; and $1,108,429 from mails and express. The train mileage was 37,416,092; passengers carried, 9,579,948; freight carried, 13,266,255 tons. The quantity of freight and number of passengers carried by the principal lines operated, during 1881-82 and 1882-83 are reported as follows:

	Tons.		Pass'gers carried.	
Name of railway.	1882-83.	1881-82.	1882-83	1881-82.
Grand Trunk system	5,522,502	6,366,358	4,563,149	4,999,991
Intercolonial	970,961	838,596	878,500	779,994
Canada Southern	2,136,369	2,129,733	574,008	312,331
Credit Valley	200,708	142,035	283,681	224,450
Northern	596,800	614,042	514,942	476,878
Midland System	514,948	522,112	338,951	306,223
Toronto, Grey & Bruce	156,331	124,560	169,881	145,649

Contracting Miscellany.

S. PENNOCK & SONS, of Kennett Square, Phila. have a contract to grade and repair 300 miles of road in Dorchester County, Md.

THE Commissioners at Lawrenceburg, O., were in session last week, and agreed to advertise for sealed proposals to build an iron bridge across Wilson Creek, the contract to be let May 26th.

THE State legislature having authorized the expenditure of $20,000, by the city of Guanajuato, Mexico, for the purpose of a thorough drainage of that city, work will be commenced without delay.

MILWAUKEE, Wis., April 30.—W. T. Casgrain, a contractor, of this city, has been awarded a contract by the Canadian Government to enlarge the Cornwall Canal, at a cost of $350,000. The canal is 17 miles long and is to be deepened seven feet, and made 100 feet wide at the base. The work will be commenced immediately, and will furnish employment for about 250 men for three year. Mr. Casgrain came to Milwaukee in 1866, and among other big jobs constructed the Sturgeon Bay Canal.

OWING to the high water in the St. Lawrence River at Montreal, the water could not be lowered in the Lachine Canal at the new basins, on the first of April as expected.

In consequence the contractors, Messrs. Rodgers & Farrell have been kept back with their work until the 20th inst., since which time they have been working about six hundred laborers, and one hundred and twenty-five stone masons and cutters, using electric lights and working night and day, trying to accomplish in twelve days what would be more than suffcient work for one month, to work it in a manner which would be profitable to themselves. But in this case, they have but object in view, to get the work done at any cost.

A NUMBER of capitalists have under consideration the lighting up of the city of Merida, Yucatan, with gas. The amount of capital invested is said to be in the neighborhood of $25,000.

ARTICLES of incorporation of the Arkansas and Twin Lakes Ditch Company have been filed with the Secretary. The capital stock is $100,000, divided into $10 shares. The incorporators and directors are: Van Wagenen, T. W. Jaycox, J. B. Chamberlain, B. B. Revett and J. Rodman. Operations are to be conduced in Lake county, and the principal office will be Leadville.

THE Cape May Pier Company has signed a contract with the Phœnix Bridge Company for the construction of a great promenade pier, to be 1,000 feet long and 30 feet wide, with three pavilions, to cost about $55,000. The iron work is, by the terms of the contract, to be finished in 60 days, and it is hoped that the entire structure will be ready for use by the 25th of June or the 1st of July.

A CONTRACT has been awarded P. Reynolds, of Rock Island, and C. C. Smith, of La Crosse, for grading 75 miles of road near Spirit Lake, Ia., north-westerly to Pipe Stone, Minn. Work will be commenced at once and completed this fall. The road runs through a prairie country, and the grading will be nearly all scraper work. The road is surveyed to Bismarck.

SUBSCRIPTIONS to the Meigs Elevated Railroad of Boston were received this week in Boston. The road is 1½ miles long between Boston and Cambridge, and will probably be vigorously pushed to completion. The directors are George A. Alden, of Cambridge, Mass.; Frank Jones, of Portsmouth, N. H.; Franklin E. Gregory, of Framingham, Mass.; John Brewster, of Cambridge, Mass.: Thomas W. Peirce, of Topsfield, Mass.; Nathan Appleton, of Boston, Mass.; Walter R. Swan, of Cambridge, Mass. The office of the company is 89 Court Street, Boston, Mass.

THE contract for furnishing 250,000 arch bricks for Race street sewer, Baltimore, Md., was awarded to H. W. Classen & Co., at $7.60 per thousand; the contract for 600 cubic yards of stone, for the same purpose, was awarded to John Curley, at $1.87 per cubic yard. Proposals for furnishing 700 barrels of cement were received as follows: John Bullock & Son, Rosendale and Roundtop, at $1.28 per barrel; Wm. Wirt Clarke & Son, Rosendale, $1.20; Roundtop, $1.30; S. M. Hamilton & Co., Cumberland, $1.18; Russell & Giese, Rosendale, $1.24. A bid for excavating, etc., of Race street sewer was received from Wm. Smith—excavating, forty cents per cubic yard; removing, fifteen cents per cubic yard. The last two contracts were not awarded.

Streets, Drainage, Sewerage, Etc.

BALTIMORE City Council last week appropriated $96,380 for sewers.

IN reply to the letter of Commodore A. A. Semmes, making suggestions to the health officer of the District as to the method of cleaning sewers, the commissioners state that the suggestion that the pneumatic process for cleaning sewer traps be adopted has heretofore been thoroughly investigated and found impracticable in this city, for the reason that a large proportion of the material to be removed is compact sand and gravel which requires the use of jacks and bars to break up. Every effort is made to render this process of trap cleaning as little offensive as the limited means available for the purpose will permit.

A COMMITTEE of property holders, of Leavenworth, Kan., have been visiting Kansas City, to examine the street paving being done there. They report as follows:

The cost of the pavement, including grading, is $2.60 per square yard, and the cost of curbing is 78 cents per lineal foot. At these rates it would cost $159.46 for paving and $18.72 for curbing per lot on our Delaware streets.

The life of the cedar blocks, according to City Engineer W. B. Knight of Kansas City, is placed at a minimum of ten years, and can be replaced at a cost of less than $1 per square yard.

Mr. James McGonigle, the Contractor, paved a street in Detroit, Mich., in 1871, and claims that it is still in good condition. The pavement was laid on sand.

Such a pavement would not cost above $93 per lot. We, however, concluded that the concrete foundation is the better and ultimately more economical, and recommend it for Delaware street as being cheaper in the end than macadam.

STATE BOARD OF HEALTH.—The State Board of Health met at the residence of Dr. C. W. Chancellor, 51 McMechin street at 2 o'clock yesterday. There were present Drs. Ward, Steuart, Teackle, Chancellor and Mr. J. Crawford Neilson, civil engineer. The secretary

stated that the regular January meeting was omitted in consequence of his severe and protracted illness. He had, however, been able to prepare and submit to the legislature the regular biennial report, of which three thousand had been distributed, principally in the State. The report, he stated, had met with an unusually complimentary reception, and had been favorably commented upon by many of the most prominet journals on account of the variety and value of its contents.

A communication was received from a committee, representing the twenty-nine State boards of health in the United States, calling a meeting of the secretaries of the various boards to be held in Washington city the 7th of May, for the purpose of conference in regard to general plans and special lines of practical sanitary work, and requesting that each delegate should prepare and read a paper upon some specific subject on which there is need for comparison of views or for co-operation.

On motion of Dr. Steuart, Dr. Chancellor, the secretary of the Maryland board, was requested to attend the meeting and read a paper, which he has carefully prepared, on the value of the eucalyptus tree as a fever-preventing and fever-destroying agent in malaria, and to request the co-operation of the several State boards in securing a liberal appropriation from Congress for the introduction and cultivation of the tree in this country. The reduction of the appropriations for public health purposes was discussed, and the following resolutions passed:

Resolved, That this board will endeavor, by increased energy, to make up for the loss to the community from the indifference and adverse legislation of the General Assembly in all matters relating to the public health, and will continue, as best they can at stated periods, the holding of sanitary conventions in the various sections of the State.

Resolved, That the secretary be requested to perfect arrangements for a convention to be held on the Eastern Shore, not later than the 15th of September next, and that he invite the co-operation of the medical profession, engineers, architects, plumbers, the clergy, editors of journals, and the people generally in this effort to promote the public health.

Resolved, That the legislature having failed to make any provision for collecting vital statistics, the secretary of this board be authorized to issue circular letters to the physicians of the State, asking them to furnish data in regard to the prevailing diseases and the number of deaths in their respective localities, and especially with reference to the prevalence of malaria and other zymotic diseases.—*Baltimore American*, Apr, 16.

Bridges.

A bridge will be built over the Sioux River at Egan, Dakota.

AT a town meeting recently held, Waterville voted to rebuild Titonic bridge across the Kennebec, at a cost of $25,000, the material used being iron.

WASHINGTON, D.C., April 11.—The house commerce committee to-day directed a favorable report to be made on the bill authorizing the Chippewa Falls and Western Railway company to construct a bridge over the St. Croix river. A similar report was directed on the bill authorizing the Winona, Alma and Northern Railway company to construct bridges across the Wisconsin, Chippewa and St. Croix rivers in Wisconsin, and also on the bill authorizing the Chicago, St. Paul and St. Louis Railroad company to construct bridges across the Mississippi river in Wisconsin and between Minnesota and Wisconsin.

Mining.

A FIVE foot vein of anthracite coal has been discovered at Black Hawk, N. M.

DENVER, Col., April 21.—The excitement over the new gold discoveries at Mount Pisgah, near Pike's Peak, is becoming intense. A thousand men are already in camp, and others are coming in from all directions by hundreds. A miners' union has been formed in the district, named "Golden Valley." Hundreds of claims were staked out yesterday, and several large companies are forming here. Leading mining men are becoming convinced that the discoveries are genuine, and the most important in the history of the State.

MINE VENTILATION.—There are many mines in Colorado where the ventilation is so bad that, after the firing of a charge, sometimes an hour or more must elapse before the miners can return to their work, and any cheap arrangement for forcing air into mines with the expenditure of little or no power and at slight cost, would be of great benefit. Several cheap expedients have been tried, some of them with great success. Very often the ventilating pipe is carried into a stove of stone tightly closed, and a fire is kept burning constantly, the air which is needed to support the combustion being drawn from the face of the drift or tunnel through the pipe. This system is used very effectually sometimes, in one case clearing a tunnel 1,400 feet long, and several hundred feet of drifts. It is, however, an exhaust system, which does not do such satisfactory work as when the air is packed into the mine.

Where timber is scarce and fuel expensive, if a small stream of water with a head of about ten feet can be brought near the mouth of the tunnel, a very cheap and satisfactory arrangement can be made of lumber, and at a very small cost. A square wooden pipe is made, about ten inches in diameter, about eight feet long. The bottom is closed, and an inch pipe a foot long inserted. Into one side of the wooden pipe, and a foot above the bottom, an orifice of the same size as the ventilating pipe is cut, and the end of the ventilating pipe is inserted. The wooden tube is set upright, and the stream of water is brought above it in a ¾-inch iron pipe, the end of which just enters the upper end of the wooden pipe. A simple arrangement is attached to the end of the supply pipe, by which the water is thrown into the wooden pipe in a spray which should completely fill the wooden pipe. The water should have a head of about ten feet.

This arrangement works somewhat like an injector, the spray or jet of water forcing down with it a current of air, which, as the bottom of the box has an orifice only large enough to admit of the water flowing out, is driven into the ventilating pipe, and through that to the face of the drift or the bottom of the shaft. This apparatus is cheap and works admirably for considerable distances.

Beyond three or four hundred feet, however, the friction of the air in the ventilating pipe seriously retards the current, unless the pipe is of inconveniently large diameter, and it generally becomes necessary to use a pressure blower, as ventilating fans giving no pressure unless run at an extreme rate of speed, are open to the same objection. It is very desirable that some cheap and small water motor should be invented which with a 20-foot head would develop a power equal to about 1-10 horse power, and which could be utilized in running a fan or light pressure blower.—*Denver Tribune.*

IRON AND STEEL TRADE NOTES.

ABRAM S. HEWITT and Edward Cooper, both of New York City have filed suit in the United States Court against the Burgess Steel and Iron Works, of Portsmouth, Ohio, to recover $50,000 actual and such additional damages as the Court may think equitable. These damages are alleged to have been sustained by them through the use by the defendants of a patent process for making steel, the patentee of which was Emile Martin, a Frenchman. Hewitt is the administrator of Martin, and he and Cooper assert that they bought from Martin the patent right. They also filed suits against the Portsmouth Iron and Steel Company and Mitchell, Tranter & Co, for the same amount in each case, alleging the same facts.

PHILADELPHIA, April 22.—"Several causes have operated to bring about the present depression in the locomotive building trade," said a member of the firm of Burnham, Parry, Williams & Co., known as the Baldwin Locomotive Company, to a Philadelphia *Times* reporter to-day, "and the paramount reason has not been, as is generally supposed, the reaction against the projection of new railroad lines. Another and more potent factor in the depressing of the industry has been the falling off of the freight traffic in all parts of the country, and I may say the world, and the consequent disinclination to increase rolling and motor stocks. This can be shown by a simple illustration. On the line of the Reading Railroad between its terminal points, there are 20 furnaces of which less than five are now in blast. The consequent falling off in transportation represents figures that are tremendous. It not only precludes the possibility of further orders for steam stocks, but also compels the disuse of present rolling facilities. This is only an illustration of what is true all over the country.

"It has been known for several months past," said James M. Swank, Secretary of the American Iron and Steel Association, "that the Baldwin Locomotive Works were running behind in orders. The firm made no secret of the matter, because it was a condition experienced by every locomotive-building firm in the country. The partial shutting down of the Baldwin Works has had, and will have, no effect on the iron industry here, as the firm has been gradually decreasing their unwrought stock and have made no extensive purchases of iron or steel for a year past in expectation of the depression in trade. It is a significant fact, however, that the steel rail market is phenominally quiet, and the production is much in excess of the demand. A year ago steel rails brought $40 a ton; they sell to-day at $32 and $33." Members of the firm of Morris, Wheeler & Co, and other iron and steel firms, while satisfied that the depression in the steam rolling stock trade would not directly affect the iron interests, agreed that the outlook of the industry was far from satisfactory.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, May 1, 1884.

The Pig Iron Market shows no new features. A number of inferior brands of Iron are being offered at very tempting prices, and are causing a slight weakening in prices of the better brands, but it is not probable that these poorer Irons will take any hold of the market; consumers as a general thing, prefer good Irons, but are buying very small lots, at $20@$20.50 for No. 1 Foundry, and $18 as an average price for No. 2. Forge Iron shows more weakness, and sales have been made at $17@$17.50; the depression in Manufactured Iron is preventing the placing of any very heavy orders by mill owners; the average amount of Iron is being bought, in spite of the dullness in all departments. The demand for Foreign Irons is light; Bessemer has weakened considerably, and large lots could be had at $20; Spiegeleisen is dull and unchanged. Steel Rails are selling in very small lots, and it is reported that $32 has been taken for one or two lots; $33@$33.50 are the usual prices, and lower prices would be taken for large lots; Bar Iron commands 2c. in small lots of best quality; but prices range from that down to 1.80 or even 1.75; country mills are taking a few good orders for Common Iron, but rolling mills are generally employed to about half capacity. Structural and Plate Irons are quiet; the Phenixville Bridge Works secured a 1,000 ton order for Iron a few days ago. Nails are quoted at $2.50@$2.60, but orders for good lots are being placed at a little less. Old Rails sell at $22.25@$23 for small lots, according to quality, but $21.50 was accepted for a 1,000 ton lot; D. H. Rails would be sold at $23.50; best No. 1 Scrap has sold at $23.50. There are large requirements for various kinds of Iron being withheld, and Iron men believe that these requirements must be presented before very long, but the market is very dull and quiet, and there seem to be no reasons for anticipating any early change for the better.

PITTSBURGH, May 1, 1884.

The demand for Pig Iron, which has been dull for a long time past, is even lighter than usual, pending the settlement of the wages dispute between the manufacturers and their workmen. If there is to be a suspense, mill men, of course, do not want to have stocks of raw Iron on their hands; there are 6 furnaces out of blast in the county, and the production is light, compared with consumption; prices show signs of weakness, and from 25c.@50c. has been taken from prices usually quoted, for one or two sales; Forge has sold all the way from $16.50@$18, and Foundry from $18@$20; no sales of Muck Bar are reported. Nails are selling at $2.35@$2.45; the prices have not been advanced since the formation of the pool, but this will probably be done before long. Old Rails have sold at $22.50 for light, and $23.50 for standard sections. The Rail mills are not booking many orders; $35 is the usual price asked for small lots. There are offers here as low as $34. Sheet, Plate and Structural Irons are quiet; a few of the Structural mills are well supplied with orders; Bar is selling slowly at 1.60c.@1.90c.; Bessemer Iron for Foundry use is selling in small lots at $20.50@$21. The strike at the Wayne Iron Works is over, the reduction of 10 per cent. having been withdrawn by the management.

COAL.

PHILADELPHIA, May 1, 1884.

There is a more active demand for Anthracite Coal this week, but most of the orders being placed, are small, consumers still doubting the ability of the combination to hold present prices. Is is thought now that the restriction agreed upon will be sufficient, but should prices weaken, it is the intention of the companies to still further curtail the output; the Western and New England Markets will undoubtedly take large quantities of Coal this year, but the small way in which their orders are being placed at present, has a very discouraging effect on the trade. Prices are being heavily shaded on inferior coals, and in some cases, less than the usual prices are being accepted for lots of good coals. At the meeting of the Lehigh and Schuylkill Exchanges a few days since, the price of Pea Coal was increased 10 cents, on account of its scarcity, and the active demand for it. The larger sizes are abundant, and in dull request. Stocks at Fort Richmond are still very near 100,000 tons, as they have been for some weeks past. Vessels are scarce, and freights are high; the amount of Coal carried by the Philadelphia and Reading Company last week was, 302,153 tons for week last reported. The Bituminous Coal trade is dull; only an occasional good contract is secured. The output of Bituminous Coal is being increased. The miners along the river are having fresh trouble with the reductions made in their wages; some of the operators in the 4th pool are now paying only 2½ per bushel.